COMMUNICATIONS ACADEMY
EMERGENCY COMMUNICATIONS
CONTINUING EDUCATION

# Mapping and GPS Use For The Auxiliary Communicator

## Or,
## Where the heck am I?????

Carl Leon, N7KUW – April 2017

# Acknowledgements

King County Search & Rescue
Oregon ACES
Priest Lake Ranger Station
Google Earth

# Why this is Important

- Activation may require responding to an unknown location
- Operators may have to travel and navigate by map and compass or GPS receiver
- Location data may be in a message in different formats we should be familiar with
- Different datums can produce location errors
- Different types of maps have unfamiliar features

# Where Are We?

Geographic – e.g., Street Address, Intersection

A Coordinate System…

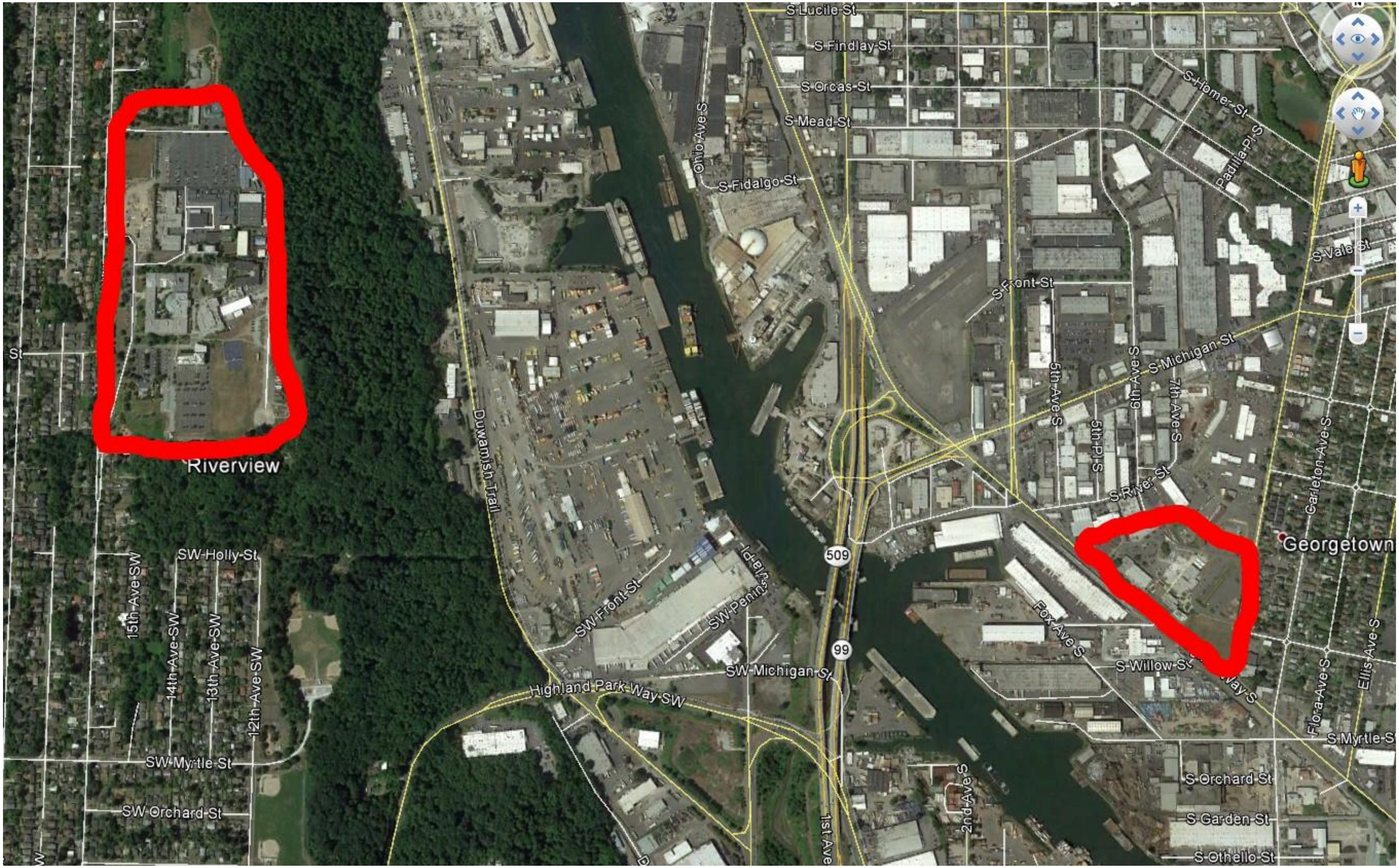
- Latitude / Longitude
- Universal Transverse Mercator (UTM)
- Military Grid Reference System – MGRS
- US National Grid – USNG

Public Land Survey System

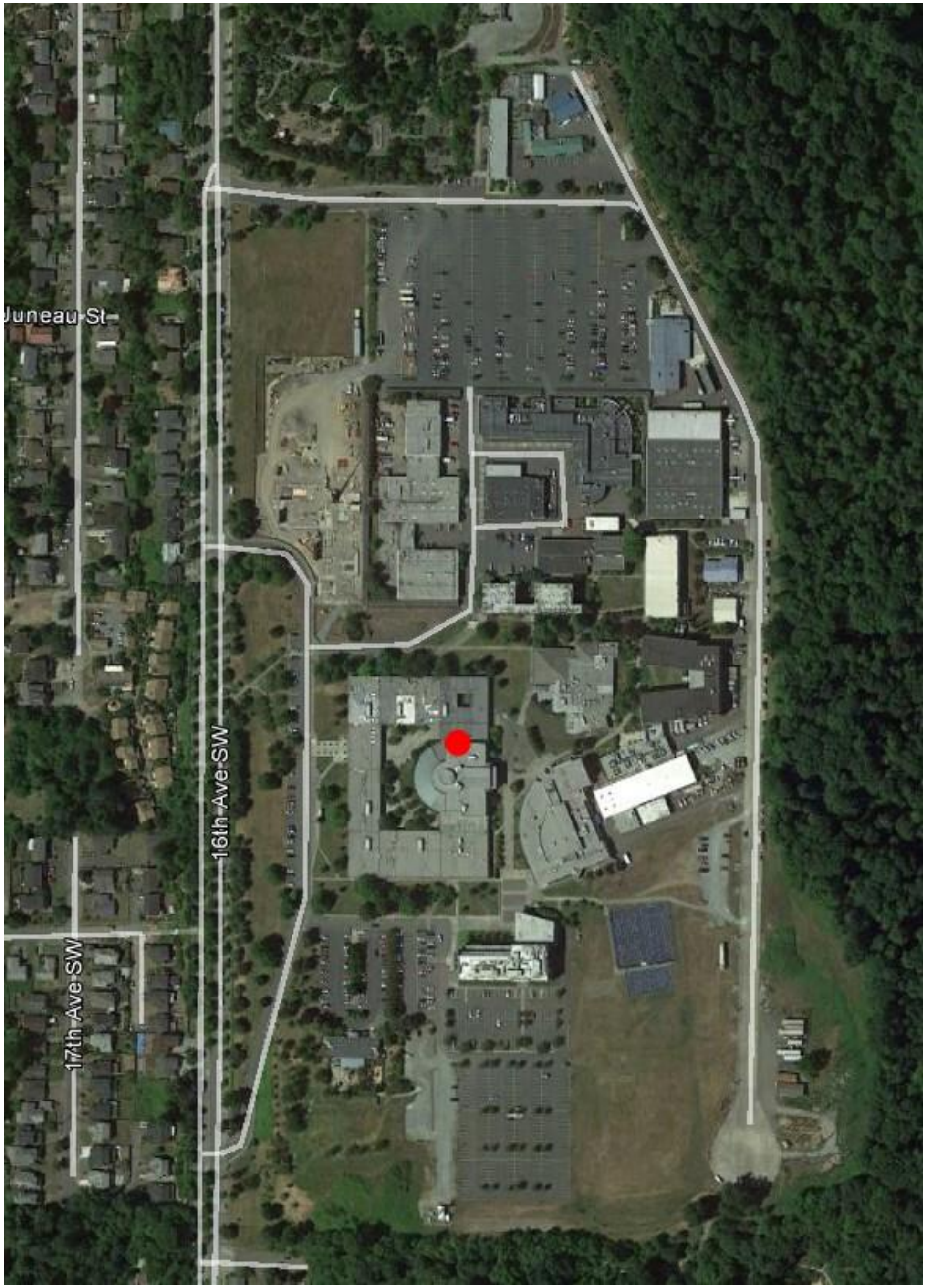
- aka Township, Range and Section

Where the heck am I?????

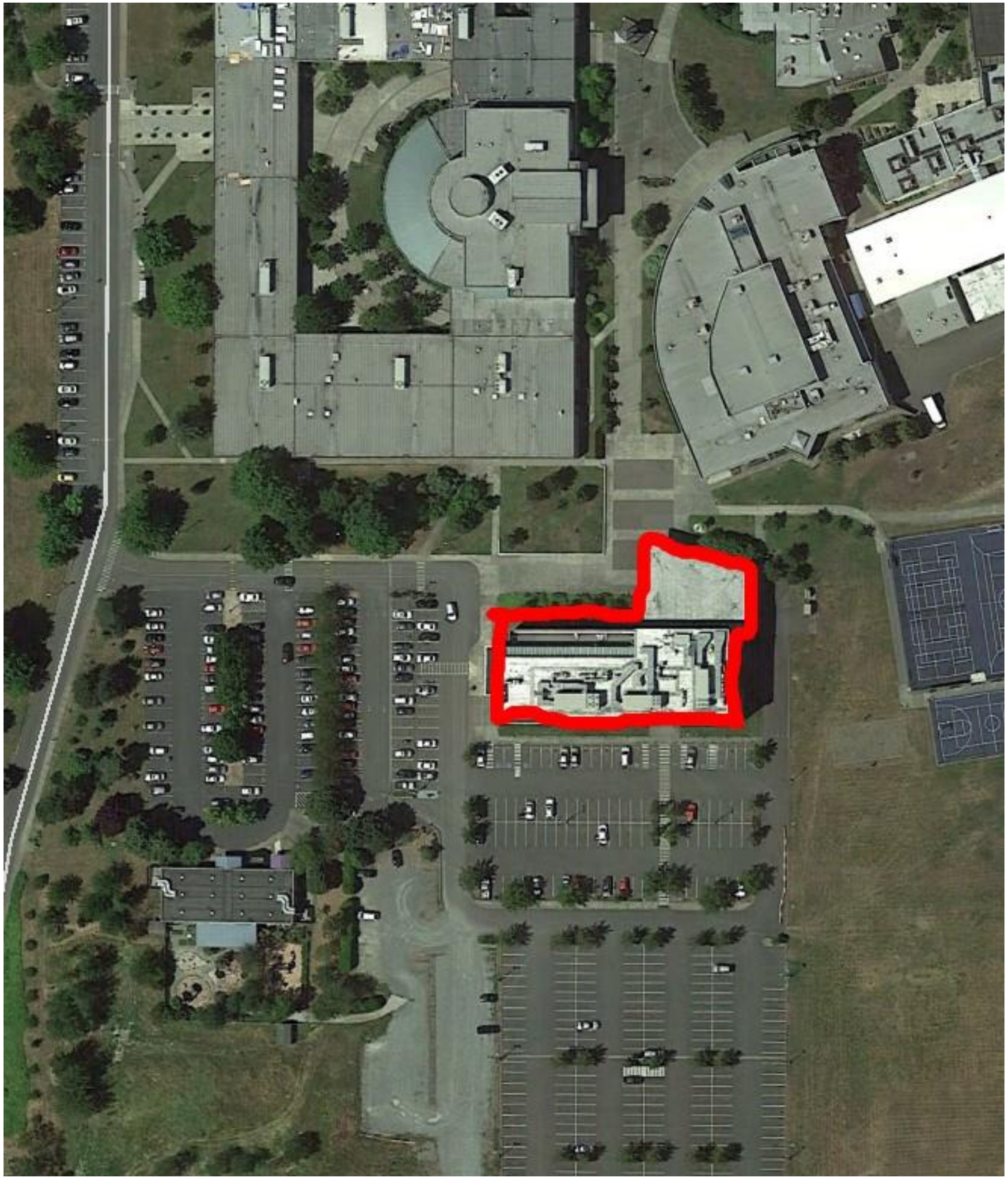
# I am at South Seattle College

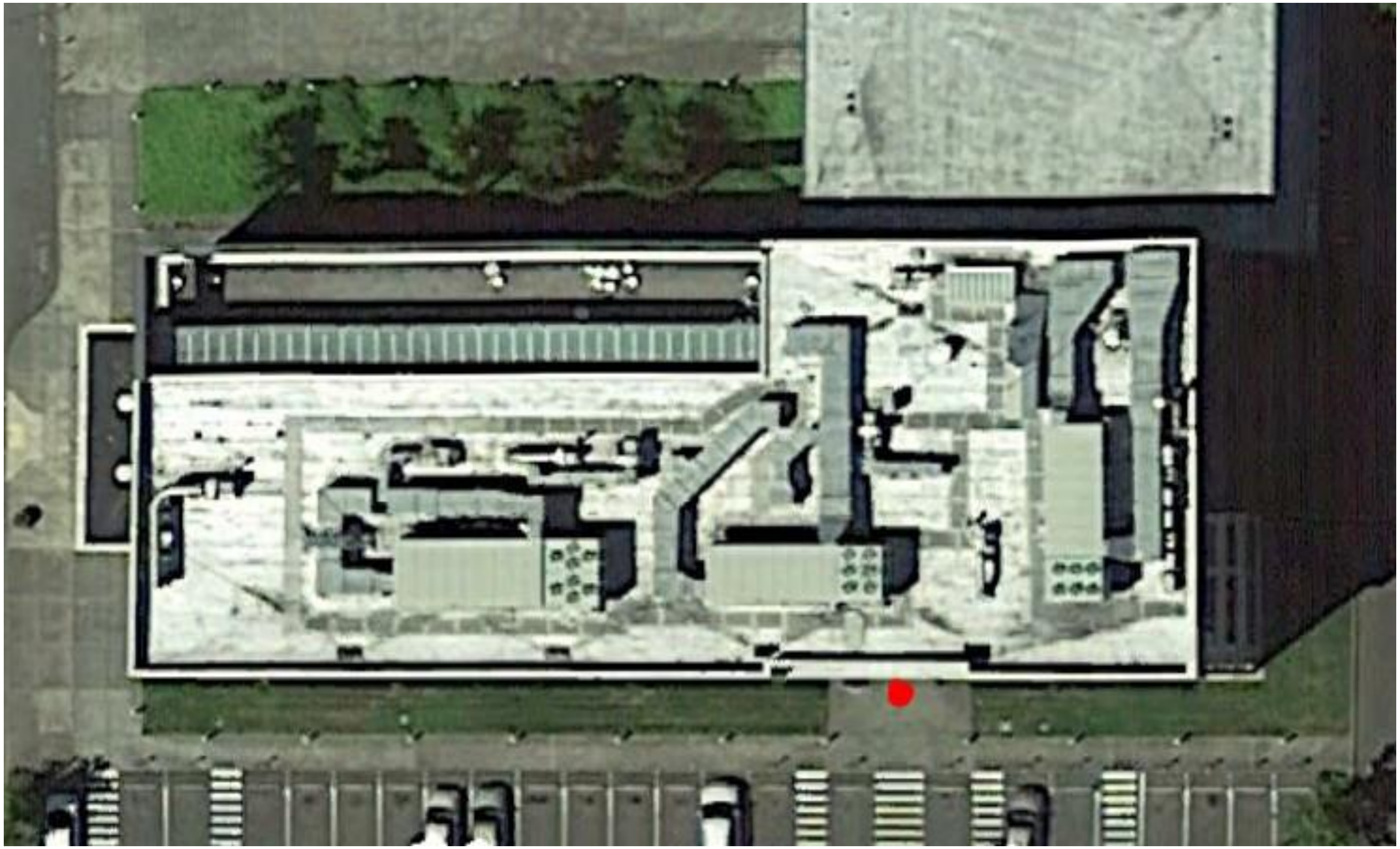


I am at 6000 16th Ave SW
Seattle, WA

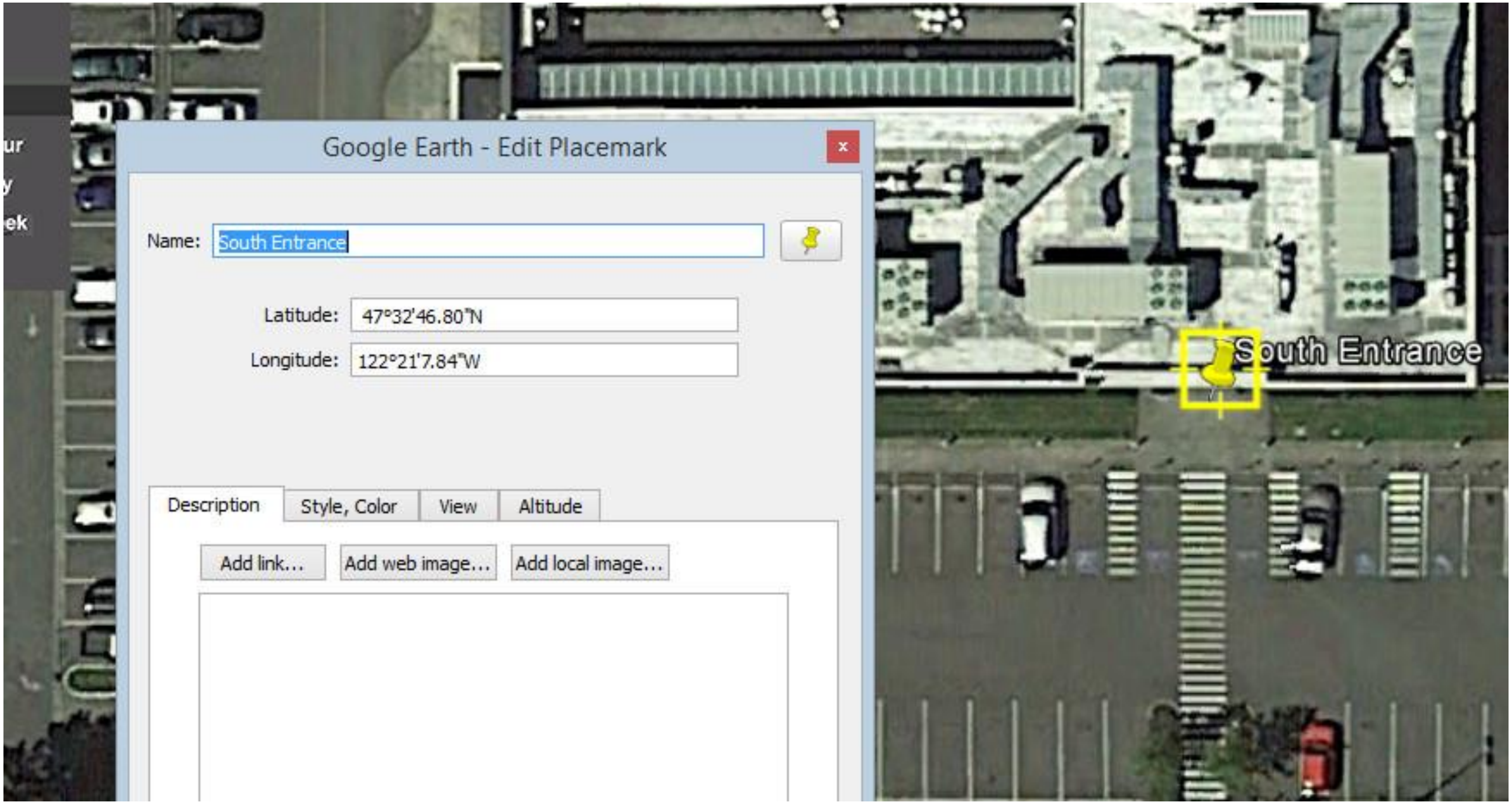


I am in Olympic Hall
At South Seattle College,
6000 16th Ave SW





I am at the South Entrance of Olympic Hall, South Seattle College, 6000 16th Ave SW, Seattle WA.



Name: South Entrance

Latitude: 47°32'46.80"N

Longitude: 122°21'7.84"W

I am at 47 degrees, 32 minutes, 46.80 seconds North Latitude,
122 degrees, 21 minutes, 7.84 seconds West Longitude
Using WGS84 Datum

Degrees, Minutes, Seconds:
47° 32’ 46.80” North, 122° 21’ 7.84” West

Degrees, Minutes, Decimal Minutes:
47° 32.780’ North, 122° 21.131’ West

Degrees, Decimal Degrees:
47.546329° North, 122.352180° West

UTM:
10T 548746.29 E 5266082.33 N
(Note: Don’t use decimal meters)

10T 548746 E 5266082 N

MGRS and USNG:
10T ET 48746 66082

# Accuracy/Resolution

Latitude-Longitude:

1 second equals about 101 feet of latitude. Longitude
Varies depending on how far north or south of equator you are.
One second of longitude where we are at is about 48 feet.

UTM / MGRS / USNG:

| | | |
|---|---|---|
| 10T 548746 | 5266082 | 1 meter = 39 inches or 3.28 feet. |
| 10T 54874 | 526608 | 10 meters = 32.8 feet |
| 10T 5487 | 52661 | 100 meters = 328 feet<br>(328.0839895 feet) |

Township/Range:

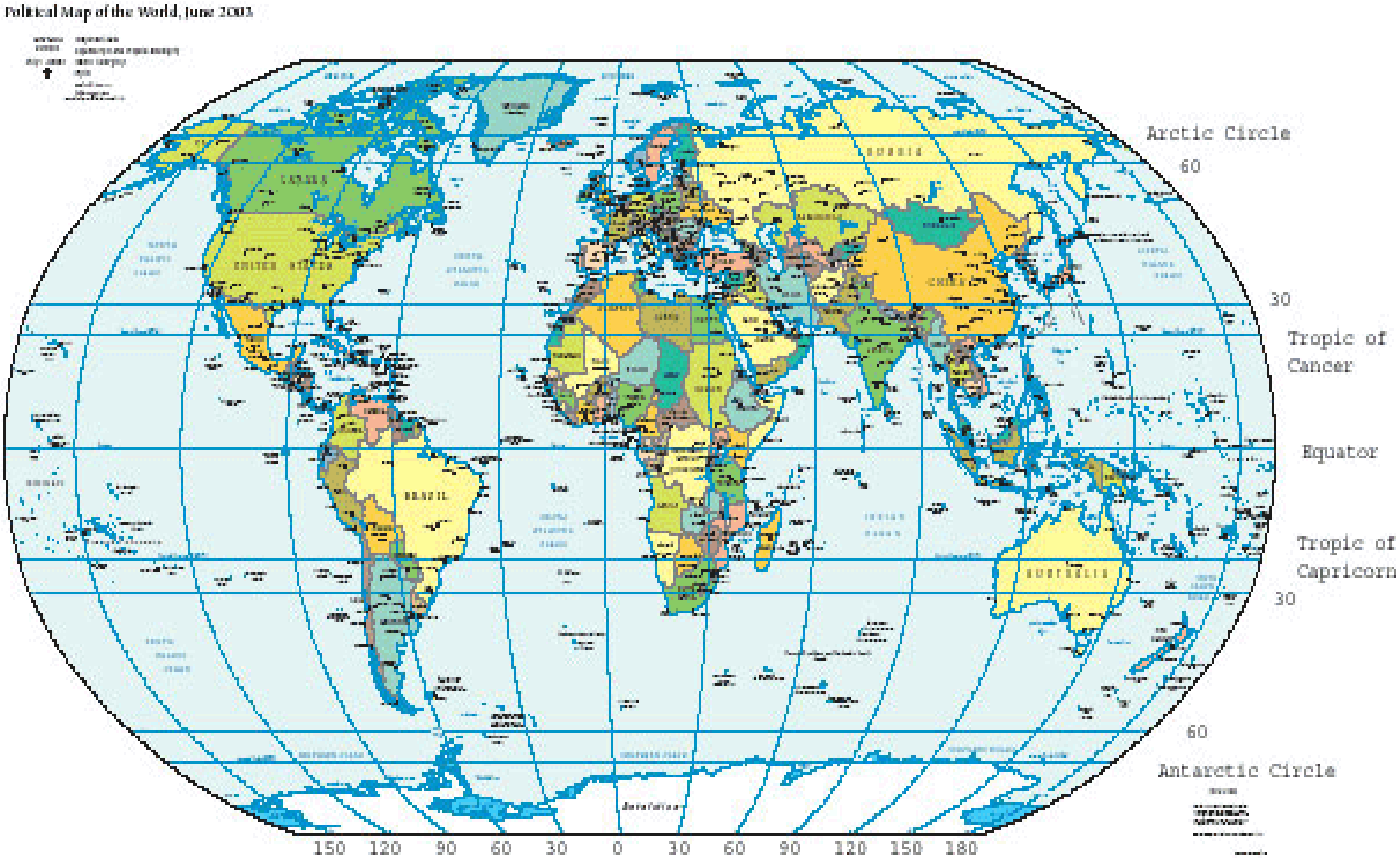
One section is one square mile.
One quarter section is ½ mile on each side
One quarter-quarter section is ¼ mile on each side, or 1320 feet.

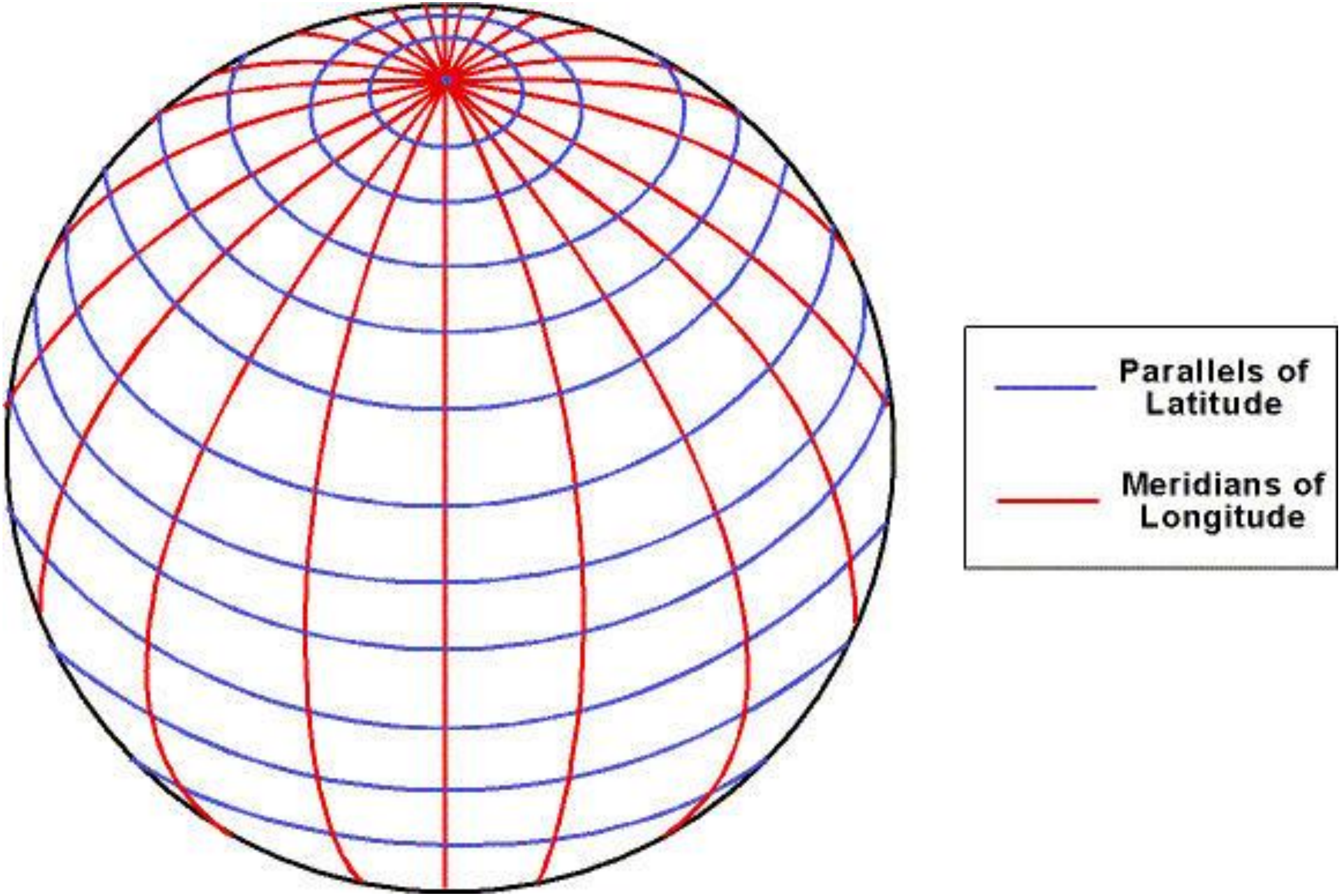
# How do I get any of these various coordinates?

Use a map and compass
(This is about a 3 day class)

Read them from a GPS
(This is about a 30 minute class)
(If you have the right type of GPS)

# Latitude and Longitude




Parallels of Latitude
Meridians of Longitude

# Position Validation

- One degree of latitude is about 60 nautical miles (69 statute miles)
    - One minute of latitude ~ one nautical mile (6,076 feet)
    - Often used by pilots and mariners for navigation
    - Longitude has no fixed distance since meridians converge at the poles

# Latitude / Longitude Position Validation

Remember…

Latitude is from zero to 90 degrees, north or south
Longitude is from zero to 180 degrees, east or west
  (or positive which is east and negative which is west)
  (we are at 122 degrees West, or -122 degrees)

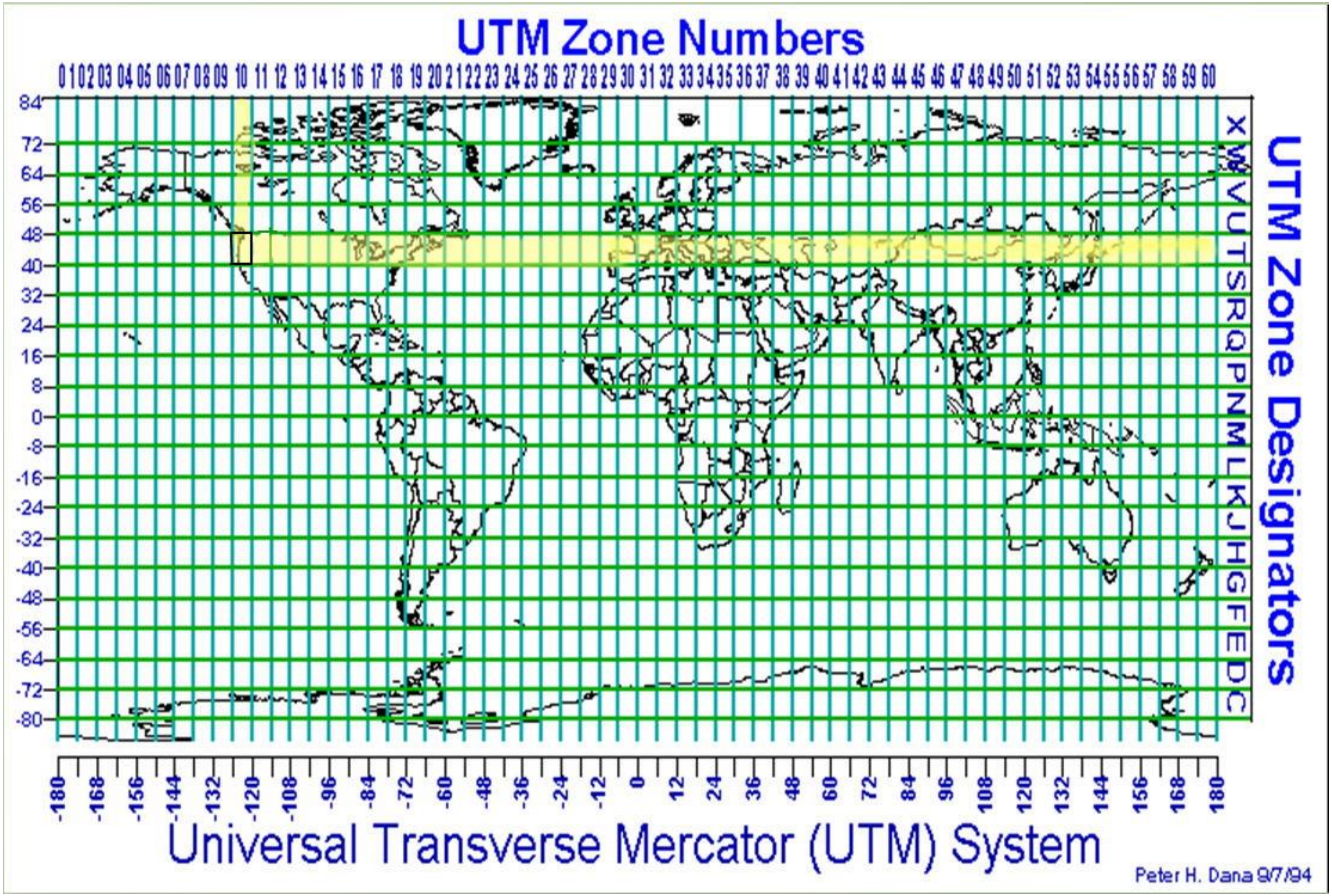
Each degree consists of 60 minutes (just like a clock)

Each minute consists of 60 seconds (just like a clock)

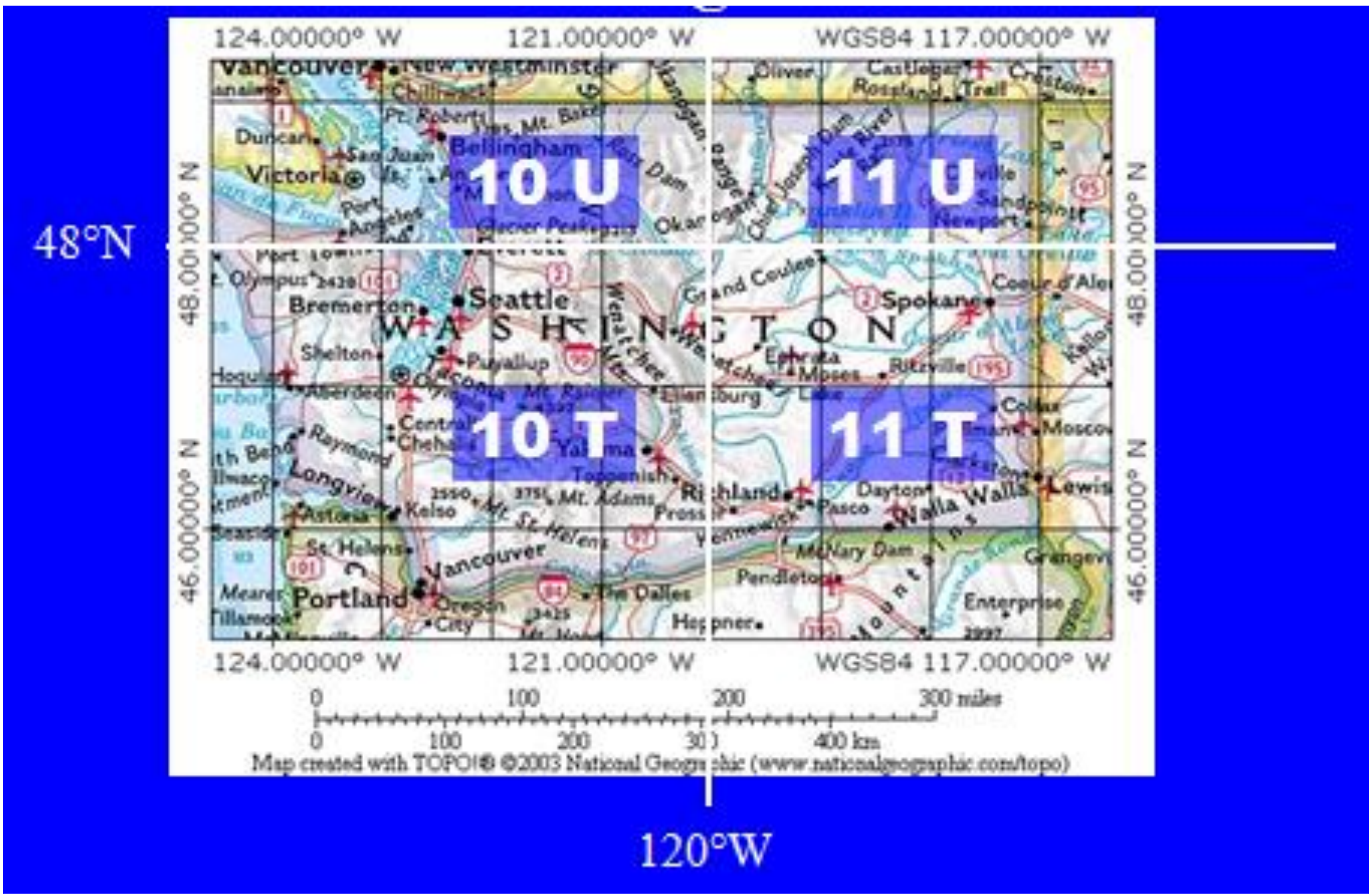
# Universal Transverse Mercator (UTM)

Metric units (meters)

- World is split into 60 zones, each 6º degrees wide
- Seattle area is Zone 10
- Distorted above North 84º, and South 80º, not applied above these latitudes (Universal Polar Stereographic, or UPS, system is used near poles).
- Coordinates get larger going east (easting) from the zone meridian and larger going north (northing) from the equator.


UTM Zone Numbers
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
84
72
64
56
48
40
32
24
16
8
0
-8
-16
-24
-32
-40
-48
-56
-64
-72
-80
X W V U T S R Q P N M L K J H G F E D C
UTM Zone Designators
-180 -168 -156 -144 -132 -120 -108 -96 -84 -72 -60 -48 -36 -24 -12 0 12 24 36 48 60 72 84 96 108 120 132 144 156 168 180
Universal Transverse Mercator (UTM) System
Peter H. Dana 9/7/94

# State of Washington UTM Zones

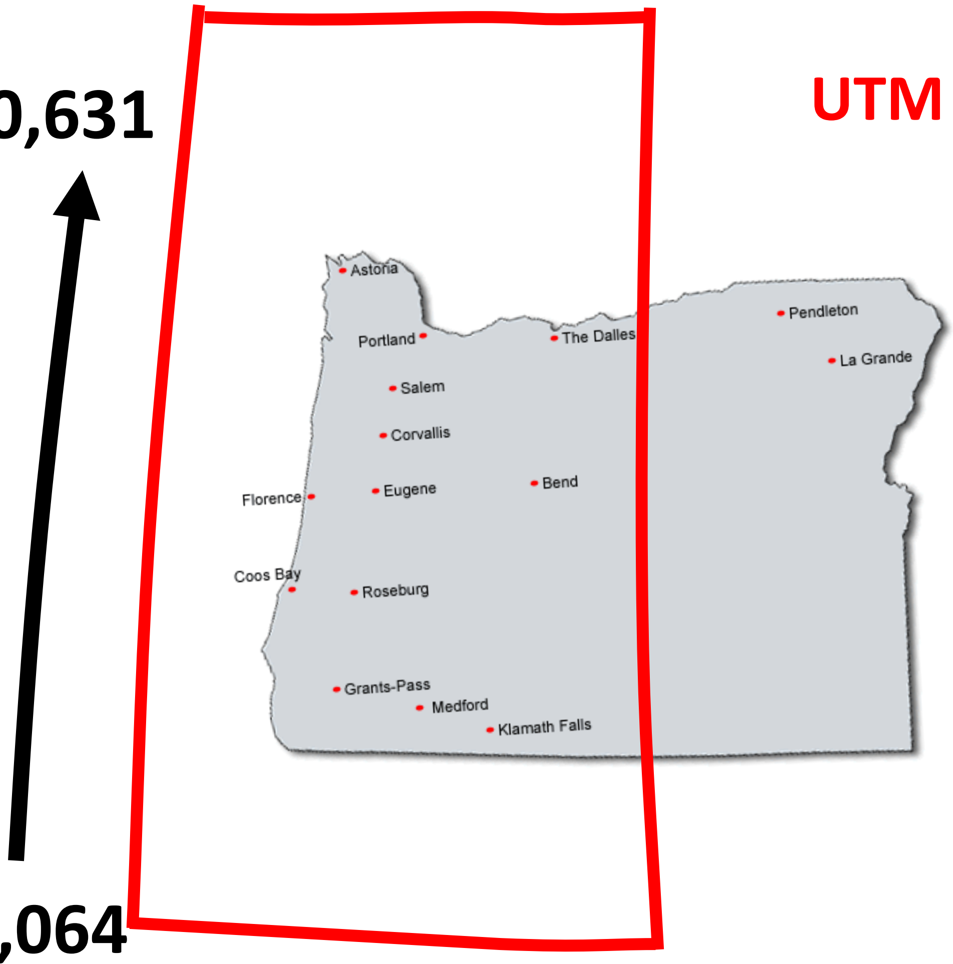


# READING UTM

- Always read RIGHT → first (Easting)
- Then Read UP ^ (Northing)

- You can define UTM to 1 Meter, 10 Meter, or 100 Meter level of precision. Use the same level of precision for easting and northing.

# Understanding Northing



**WA highest is**
**5,431,453**

**5,320,631**

**UTM Zone 10**

(388,021 meters,
Or 241 miles)

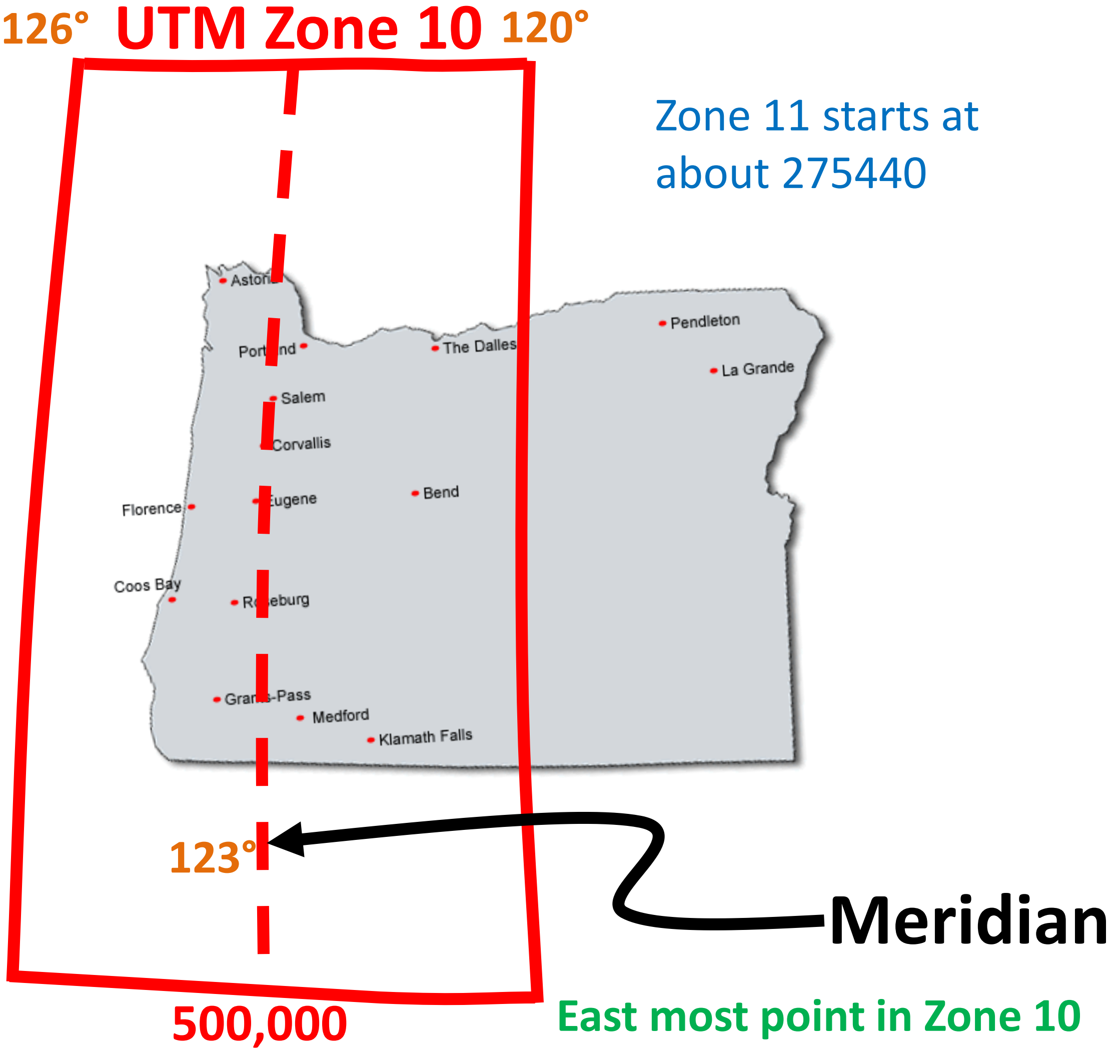
**WA Lowest is**
**5,043,432**
**(about 3,133 mi)**

**4,432,064**

**The Northing values are the number of meters north of the equator! They increase as you go North.**

# Understanding Easting

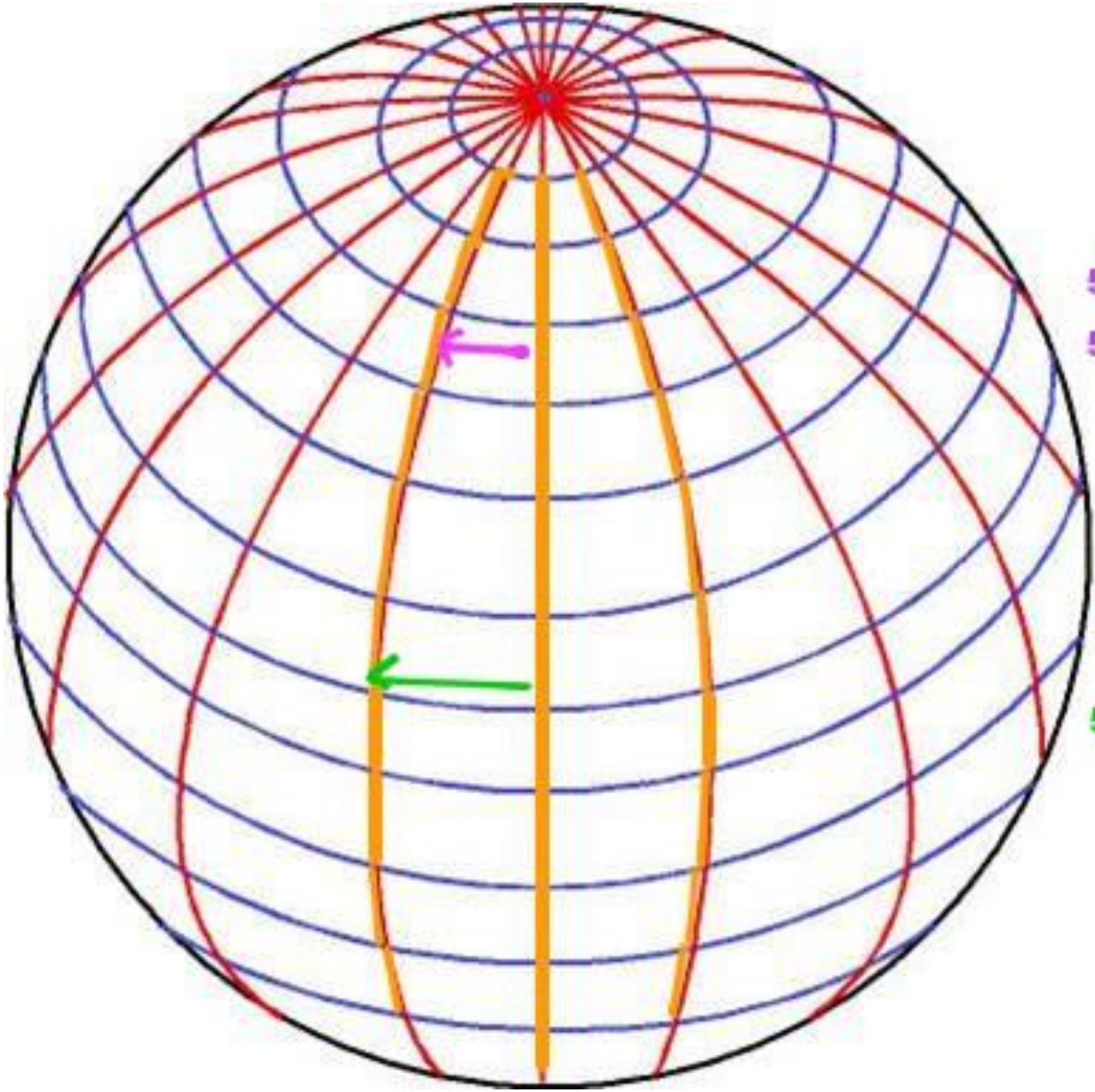
To make each zone understandable we place a line down the center of the zone called the **Meridian.** This line has a value of 500,000. **As we travel to the west of the Meridian line, the value decreases. Traveling east of the Meridian, the value increases.** The units are in meters.



Zone 11 starts at about 275440

West most Point in WA Is about 368830 (Or about 131,170 meters west of meridian)

East most point in Zone 10 in WA is about 723032 (or about 223,032 meters east)



500,000 - 250,000 = 250,000

500,000 + 250,000 = 750,000

500,000 - 490,000 = 10,000

500,000 + 490,000 = 990,000

# Military Grid Reference System

## Based on UTM

Uses 6d x 8d grid zone designator (GZD) **10T**

(Same as UTM zone and latitude band)

100,000 meter square identification **FT**

(Not used in UTM)

Numerical Location **14892 53426**

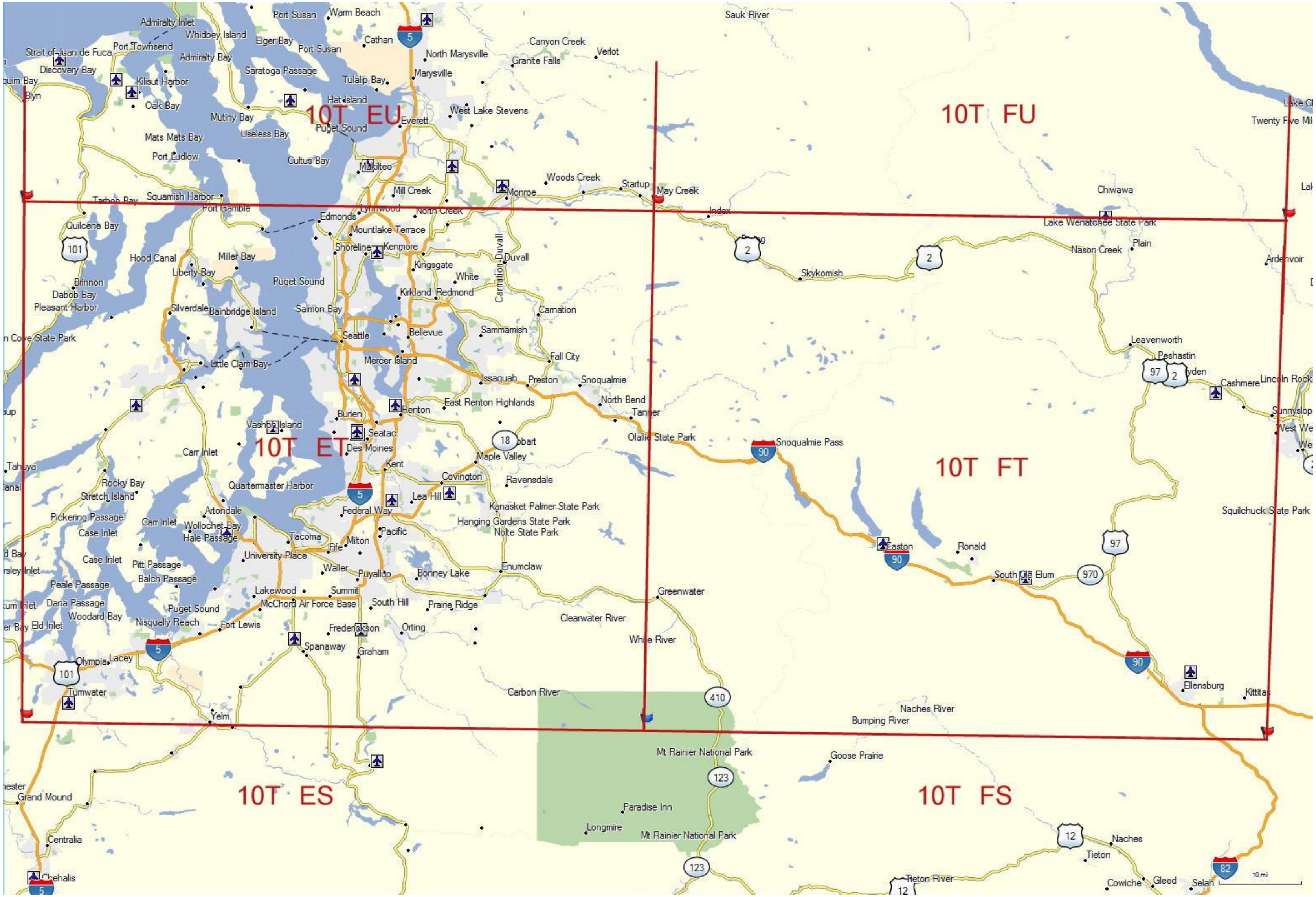
(always same number of digits for easting and northing).

Example MGRS: 10T FT 14892 53426

UTM: 10T 614892 5253426

Note that with MGRS you add the grid designator (FT in this case), but drop the most significant digits of easting (6) and northing (52).

# MGRS Grids in our area



# US NATIONAL GRID (USNG)

The Department of Homeland Security specified that there will be a national mapping coordinate standard in the United States, and that standard is the US National Grid.

USNG is based on MGRS, and for all points within the US and it's territories and possessions, shall be the same as MGRS. For our purposes MGRS and USNG are identical.

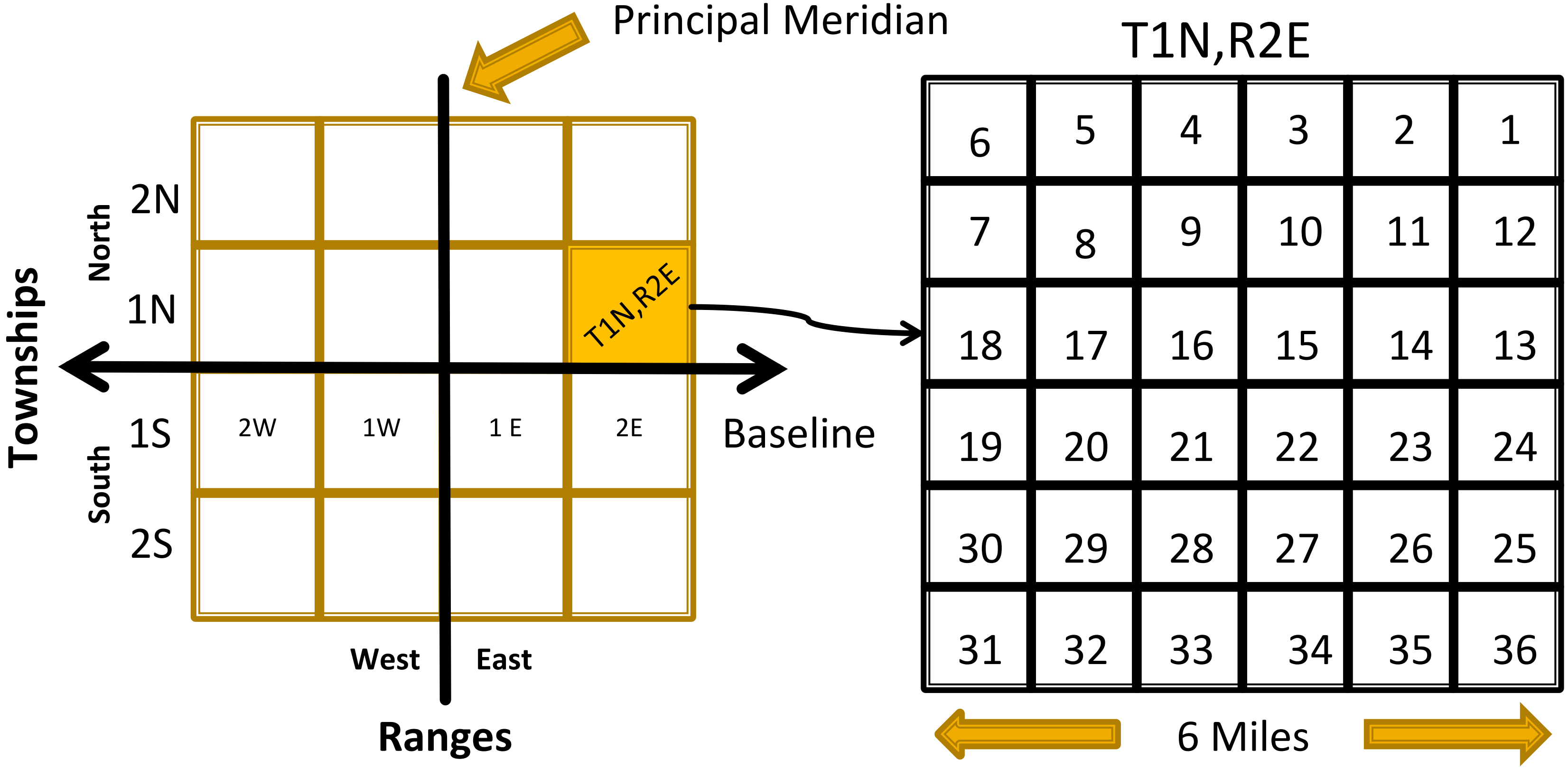
USNG will always use WGS84 datum. There are actually two MGRS variations, one (older) which uses NAD27 and one (newer) that uses WGS84. For our purposes we will only concern ourselves with the newer, current MGRS system.

WGS84 is based upon (is the same as) NAD83.

# Public Land Survey System (Township, Range, Section)

- Established after the Revolutionary War
- Managed by the Bureau of Land Management
- Typically divides land into 6 mile square townships
- Further subdivided into 36 one mile square sections
- Sections can be further subdivided
  - Quarter sections
  - Quarter-Quarter Sections
  - Irregular shapes or descriptions of land features

# PLSS Notation

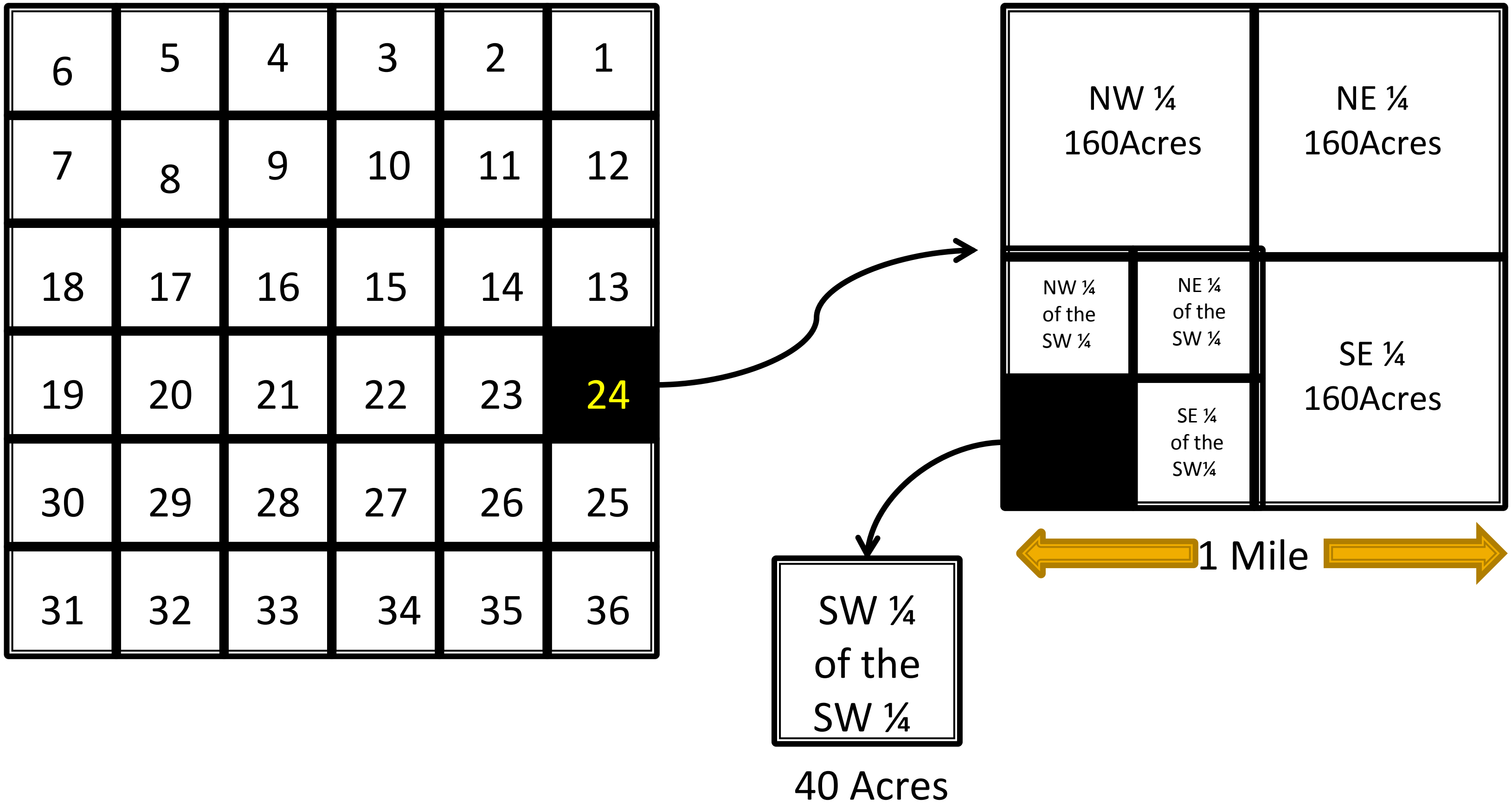


T1N,R2E

| | | | | | |
|---|---|---|---|---|---|
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 |

# PLSS Notation

Read as: “The SW quarter of the SW quarter of Section 24, Township 1N, Range 2E”



|  |  |  |  |  |  |
|---|---|---|---|---|---|
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 |

NW ¼
160Acres

NE ¼
160Acres

NW ¼
of the
SW ¼

NE ¼
of the
SW ¼

SE ¼
of the
SW¼

SE ¼
160Acres

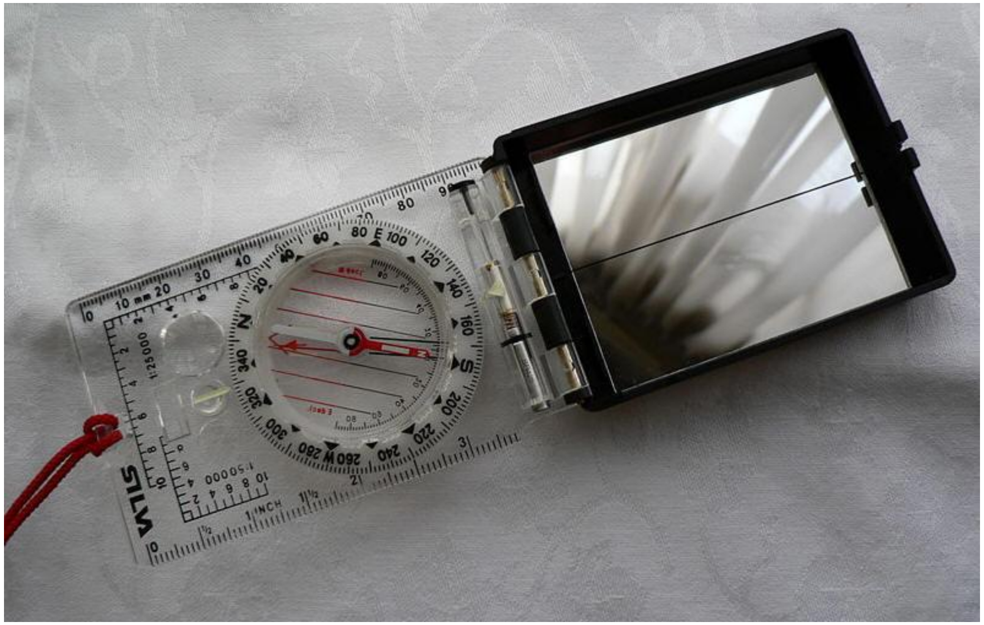
1 Mile

SW ¼
of the
SW ¼

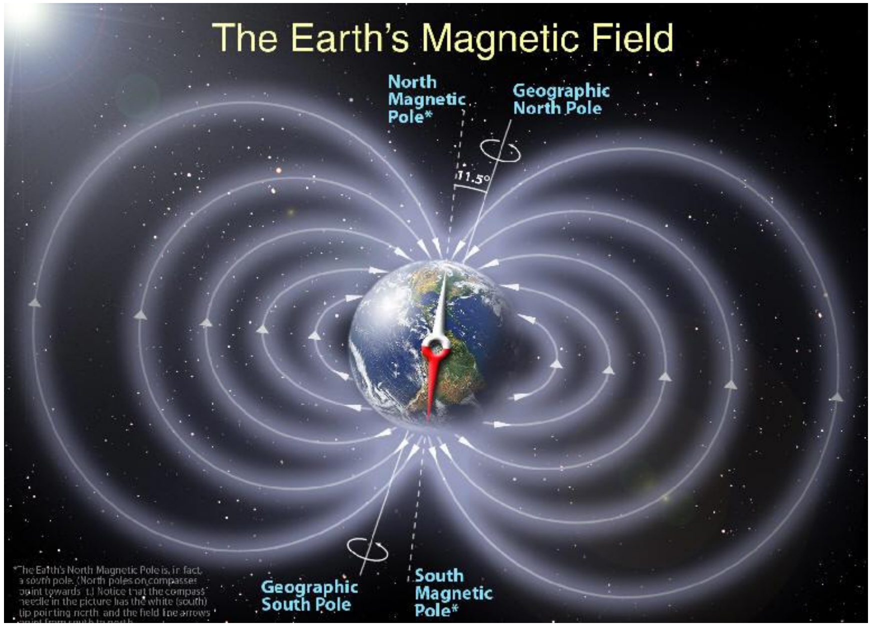
40 Acres

# Compass

- A magnetic needle that aligns with the magnetic field lines of the Earth.



# Declination


The Earth's Magnetic Field
North Magnetic Pole*
Geographic North Pole
11.5°
Geographic South Pole
South Magnetic Pole*
*The Earth's North Magnetic Pole is, in fact, a south pole. (North poles on compasses point towards it.) Notice that the compass needle in the picture has the white (south) tip pointing north, and the field line arrows

The difference between True north and Magnetic North.

In Western Washington, as of April2017, the declination is 15.85 degrees East. It is changing by abut 10 minutes west per year. (15.85° = 15° 51')

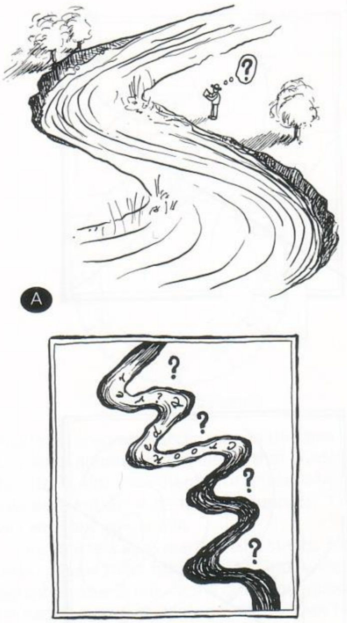
What that means is that magnetic north is 15.85 degrees east of true north. Using a compass, you need to SUBTRACT 15.85 degrees from your compass reading to obtain true north.

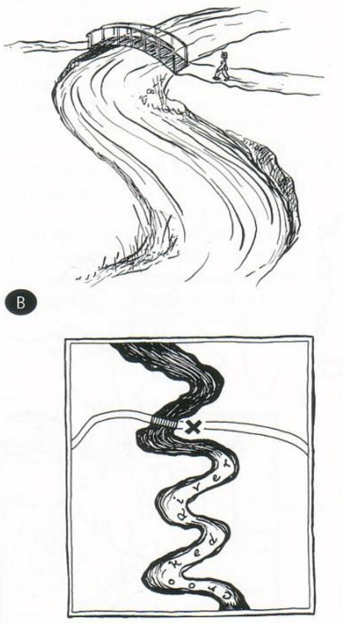
If your compass needle is set to exactly zero and pointed to magnetic north, true north will be at a bearing of 344 degrees 9 minutes.

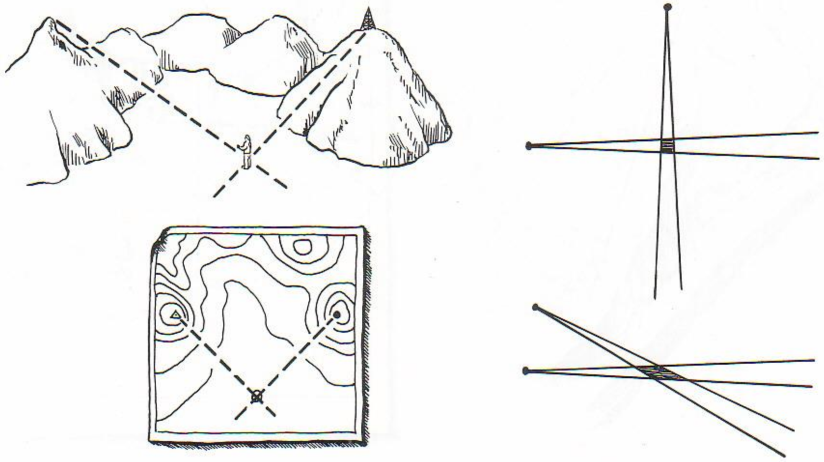
# Lines and Points of Reference

- You need two or more lines of reference, or reference points, to find your location. A line of reference can be a road, trail, river, elevation contour, or bearing to a landmark.

- Your location is where the reference lines intersect.

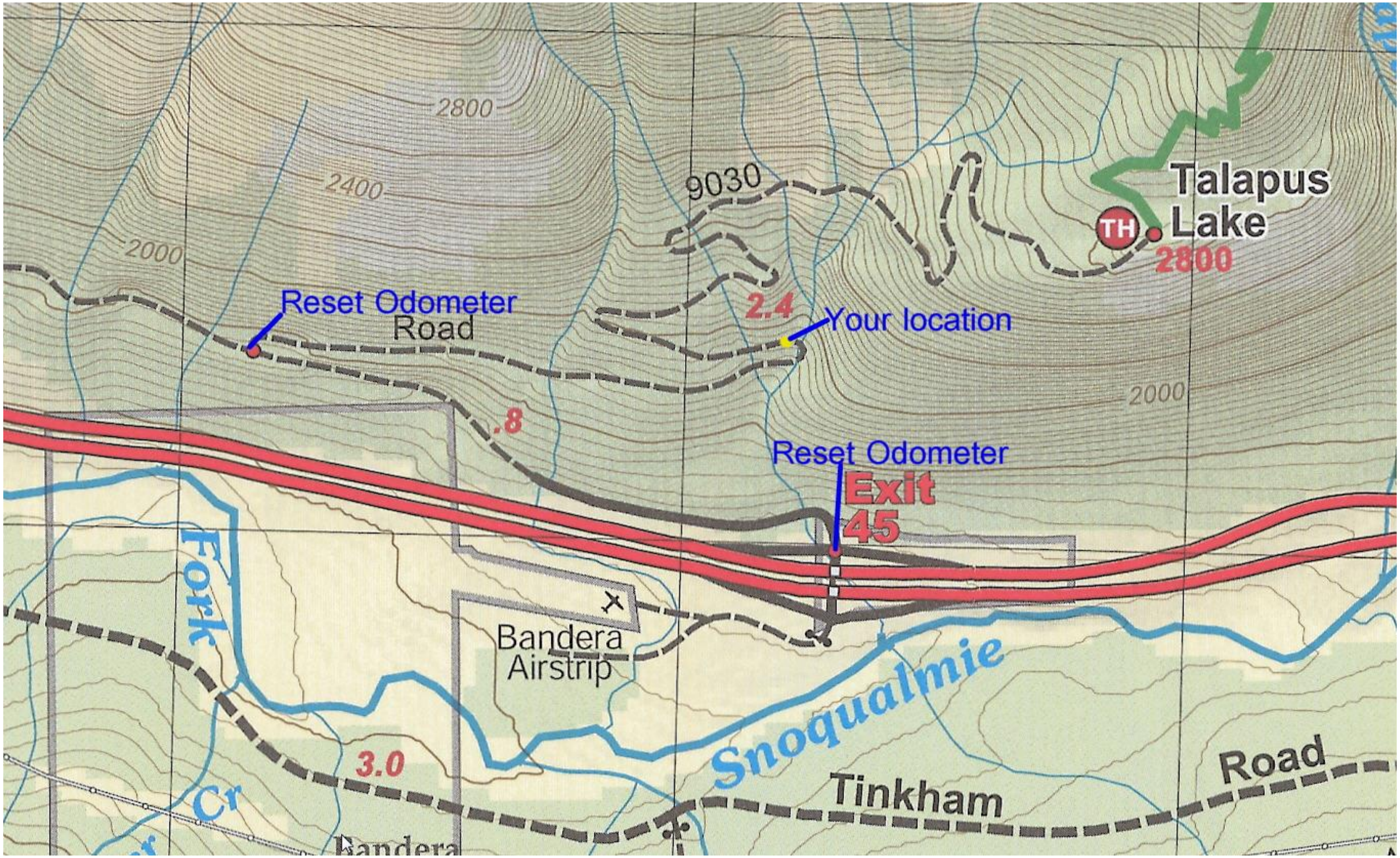






*When two bearings cross at an angle near 90 degrees (left), you get a close read of your position (shaded area, upper right). A poor crossing angle (bottom right) yields a sloppy position estimate.*

In a vehicle, zero your odometer at major turns and intersections and keep track of mileage. Distance up a road also allows you to identify/specify your location.



# GLOBAL POSITIONING SYSTEM (GPS)

# WHICH GPS UNIT?

- Many popular brands and models
- Want a mapping GPS that allows you to choose coordinate system, and specify DATUM to use.
- If you own a GPS, use it and learn how to do the various functions and operations we discuss.

# OBSTACLES TO GPS USE

- Poor Satellite Visibility
  - Cliffs
  - Heavy tree cover
  - Buildings
- Signal Multipath
  - Water
  - Buildings
- Battery Life
- Electronics Fail

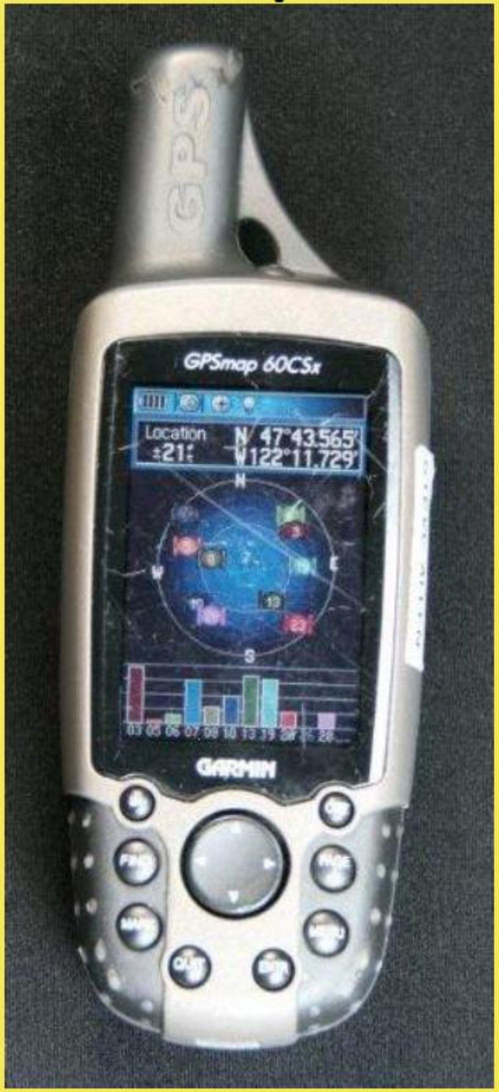
# COORDINATE SYSTEMS AND YOUR GPS UNIT

You need to make sure your GPS unit is set for the appropriate coordinate system (positional units and map datum) before you enter numbers into the unit

- Degree, minutes, seconds (NAD 27 or NAD 83/WGS 84)
- Degrees, decimal minutes (NAD 27 or NAD83/WGS 84)
- Degrees (NAD 27 or NAD 83/WGS 84)
- UTM (NAD 27 or NAD 83/WGS 84)

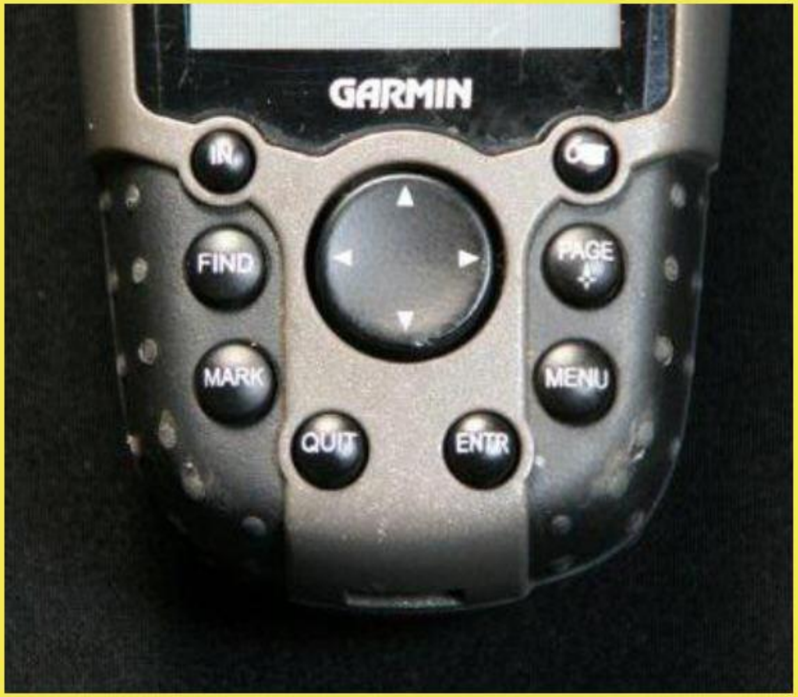
# Start-Up and Satellite Acquisition

- On / Off button on top
- Wait to acquire satellites
- Needs at least 4 satellites to get accurate 3D location
- May take several minutes



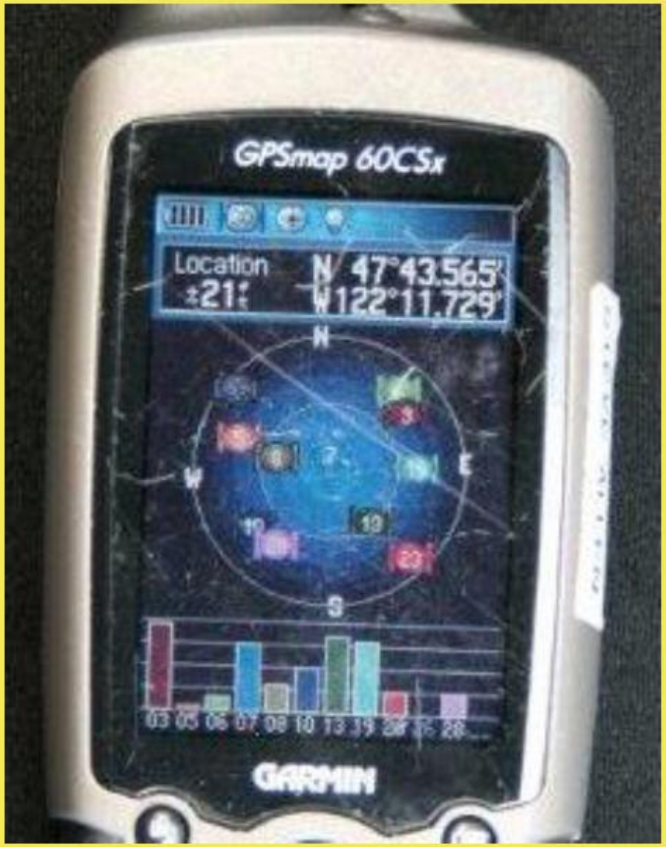
# Key/Button Functions

- In / Out Zoom
- Find (waypoint)
- Mark (waypoint)
- Quit – cancel or backup
- Enter an option
- Menu – view options
- Page – cycle through pages and turn compass on/off
- Rocker key – move up/down right/left



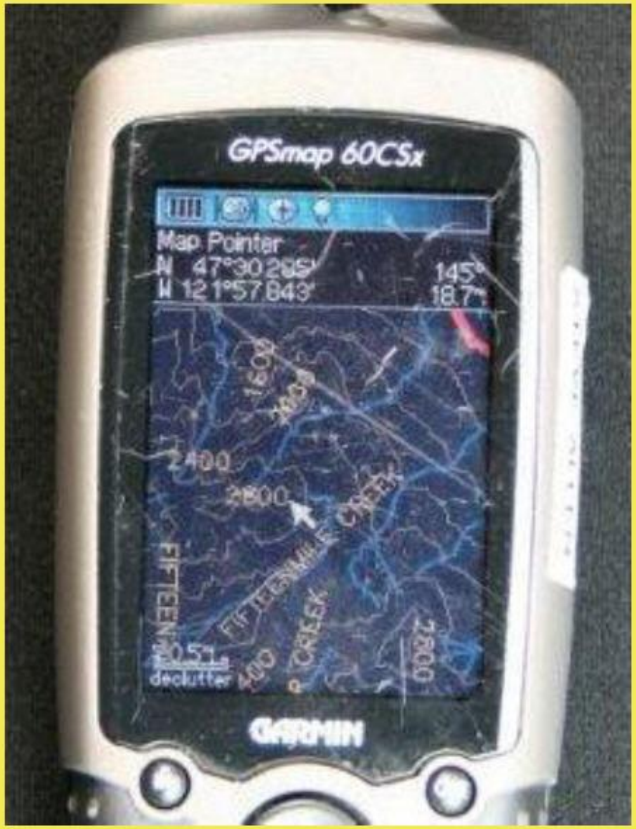
# Satellite Page

- Battery indicator
- Location/accuracy
- Satellites received
- Signal strength



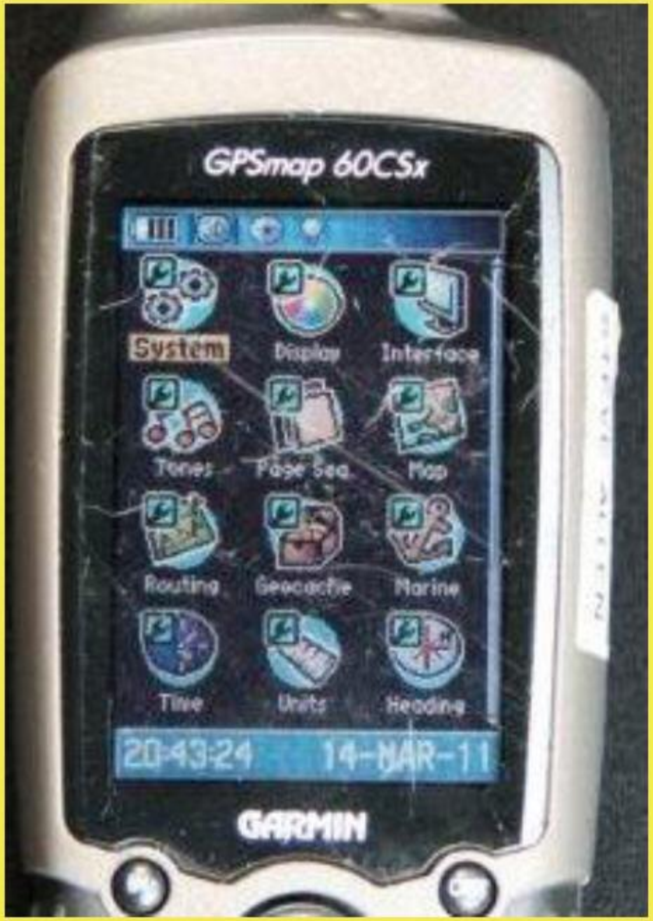
# Map Page

- Map backgrounds
  - available free from gpsfiledepot.com
- Trail maps
  - available free from switchbacks.com
- Your location
- Map pointer
- Track log display



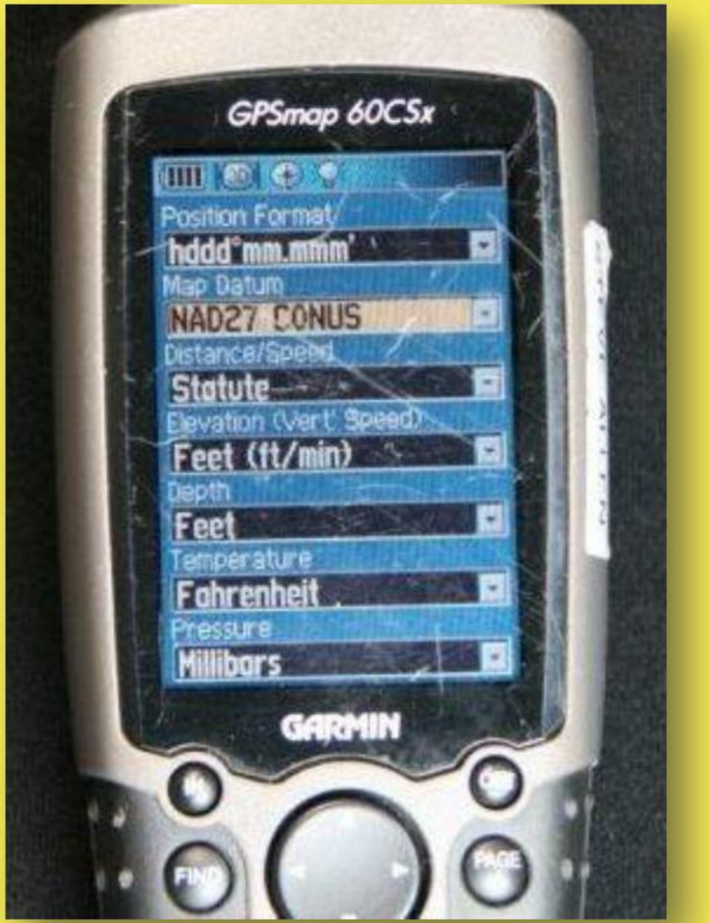
# Main / Setup

- System
- Display
- Map
- Units
- Heading
- Other …

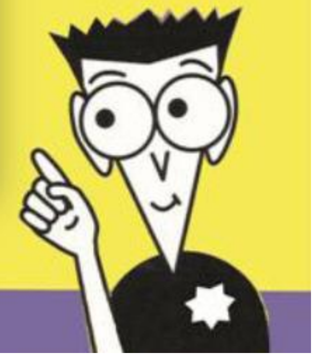


# Main / Setup / Units

- Setup
  - Positional Format
    - hddd.ddddd°
    - hddd° mm.mmm’
    - hddd° mm” ss.s’
    - UTM UPS
  - Map Datum
    - NAD27 CONUS
    - NAD83
    - WGS 84
  - Distance/Speed
    - Statute



Position Format
hddd°mm.mmm'
Map Datum
NAD27 CONUS
Distance/Speed
Statute
Elevation (Vert. Speed)
Feet (ft/min)
Depth
Feet
Temperature
Fahrenheit
Pressure
Millibars

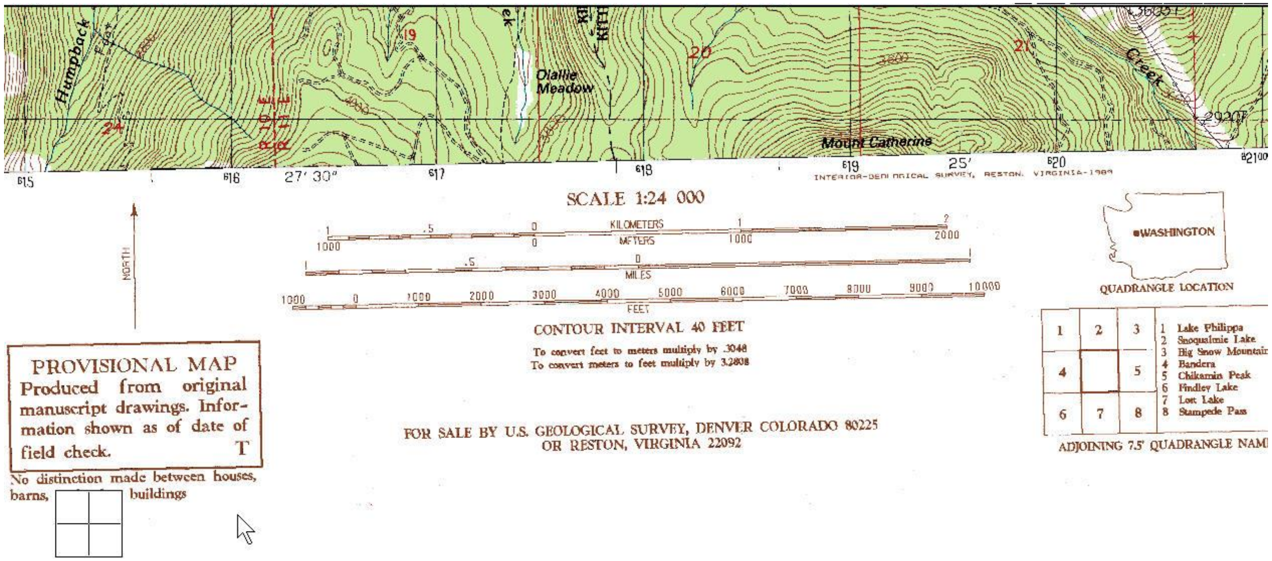


# Waypoints

- Two basic functions of your GPS unit
  1. Mark a location (waypoint)
  2. Navigate to a location (“Go To” or “find” a waypoint)

- These are the main reasons that you have a GPS unit

# Map Scale and Datum



SCALE 1:24 000

CONTOUR INTERVAL 40 FEET

To convert feet to meters multiply by .3048
To convert meters to feet multiply by 3.2808

FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER COLORADO 80225
OR RESTON, VIRGINIA 22092

QUADRANGLE LOCATION

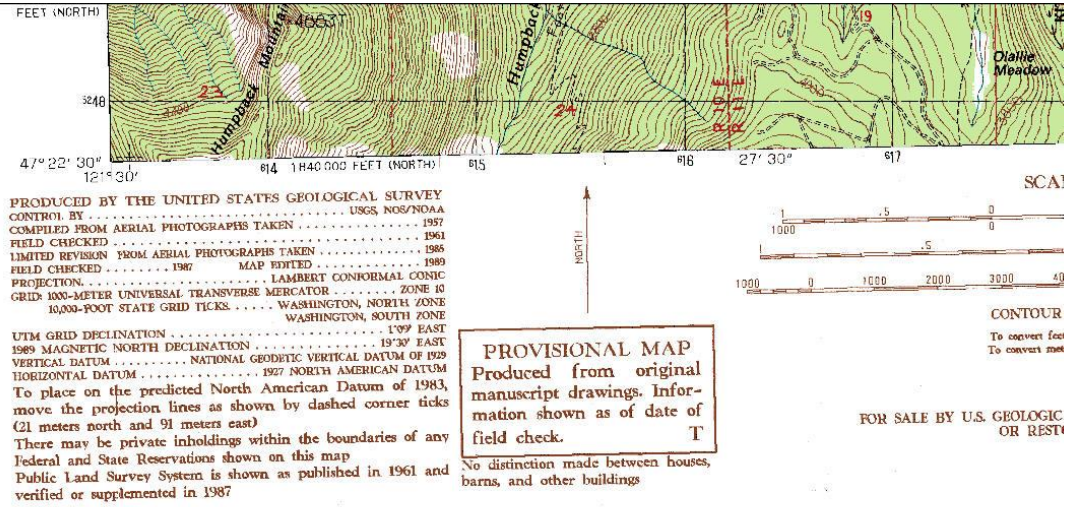
1 Lake Philippa
2 Snoqualmie Lake
3 Big Snow Mountain
4 Bandera
5 Chikamin Peak
6 Findley Lake
7 Lost Lake
8 Stampede Pass

ADJOINING 7.5′ QUADRANGLE NAM

PROVISIONAL MAP
Produced from original manuscript drawings. Information shown as of date of field check. T

No distinction made between houses, barns, buildings

Scale and rulers. Scale is the ratio of the distance on the map to the distance on the ground.



PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY
CONTROL BY .......... USGS, NOS/NOAA
COMPILED FROM AERIAL PHOTOGRAPHS TAKEN .......... 1957
FIELD CHECKED .......... 1961
LIMITED REVISION FROM AERIAL PHOTOGRAPHS TAKEN .......... 1985
FIELD CHECKED .......... 1987 MAP EDITED .......... 1989
PROJECTION .......... LAMBERT CONFORMAL CONIC
GRID: 1000-METER UNIVERSAL TRANSVERSE MERCATOR .......... ZONE 10
10,000-FOOT STATE GRID TICKS .......... WASHINGTON, NORTH ZONE
WASHINGTON, SOUTH ZONE
UTM GRID DECLINATION .......... 1°09′ EAST
1989 MAGNETIC NORTH DECLINATION .......... 19°30′ EAST
VERTICAL DATUM .......... NATIONAL GEODETIC VERTICAL DATUM OF 1929
HORIZONTAL DATUM .......... 1927 NORTH AMERICAN DATUM

To place on the predicted North American Datum of 1983, move the projection lines as shown by dashed corner ticks (21 meters north and 91 meters east)

There may be private inholdings within the boundaries of any Federal and State Reservations shown on this map

Public Land Survey System is shown as published in 1961 and verified or supplemented in 1987

PROVISIONAL MAP
Produced from original manuscript drawings. Information shown as of date of field check. T

No distinction made between houses, barns, and other buildings

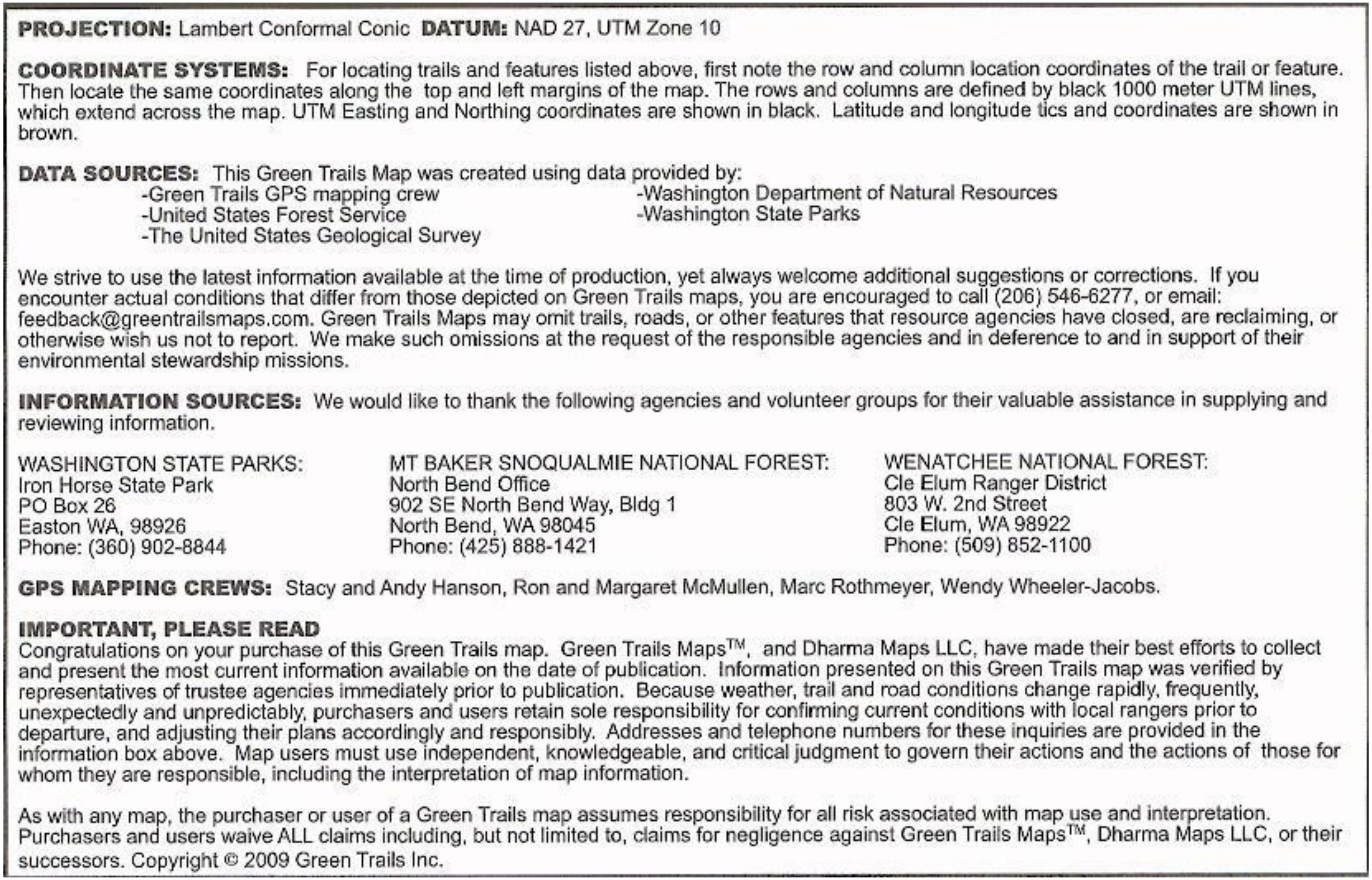
CONTOUR

To convert fee
To convert met

FOR SALE BY U.S. GEOLOGIC
OR REST

Horizontal Datum … 1927 North American Datum, or NAD27. The other common datum you will see is WGS84.

# Datum on Green Trails 207S



**PROJECTION:** Lambert Conformal Conic **DATUM:** NAD 27, UTM Zone 10

**COORDINATE SYSTEMS:** For locating trails and features listed above, first note the row and column location coordinates of the trail or feature. Then locate the same coordinates along the top and left margins of the map. The rows and columns are defined by black 1000 meter UTM lines, which extend across the map. UTM Easting and Northing coordinates are shown in black. Latitude and longitude tics and coordinates are shown in brown.

**DATA SOURCES:** This Green Trails Map was created using data provided by:

-Green Trails GPS mapping crew
-United States Forest Service
-The United States Geological Survey
-Washington Department of Natural Resources
-Washington State Parks

We strive to use the latest information available at the time of production, yet always welcome additional suggestions or corrections. If you encounter actual conditions that differ from those depicted on Green Trails maps, you are encouraged to call (206) 546-6277, or email: feedback@greentrailsmaps.com. Green Trails Maps may omit trails, roads, or other features that resource agencies have closed, are reclaiming, or otherwise wish us not to report. We make such omissions at the request of the responsible agencies and in deference to and in support of their environmental stewardship missions.

**INFORMATION SOURCES:** We would like to thank the following agencies and volunteer groups for their valuable assistance in supplying and reviewing information.

WASHINGTON STATE PARKS:
Iron Horse State Park
PO Box 26
Easton WA, 98926
Phone: (360) 902-8844

MT BAKER SNOQUALMIE NATIONAL FOREST:
North Bend Office
902 SE North Bend Way, Bldg 1
North Bend, WA 98045
Phone: (425) 888-1421

WENATCHEE NATIONAL FOREST:
Cle Elum Ranger District
803 W. 2nd Street
Cle Elum, WA 98922
Phone: (509) 852-1100

**GPS MAPPING CREWS:** Stacy and Andy Hanson, Ron and Margaret McMullen, Marc Rothmeyer, Wendy Wheeler-Jacobs.

**IMPORTANT, PLEASE READ**

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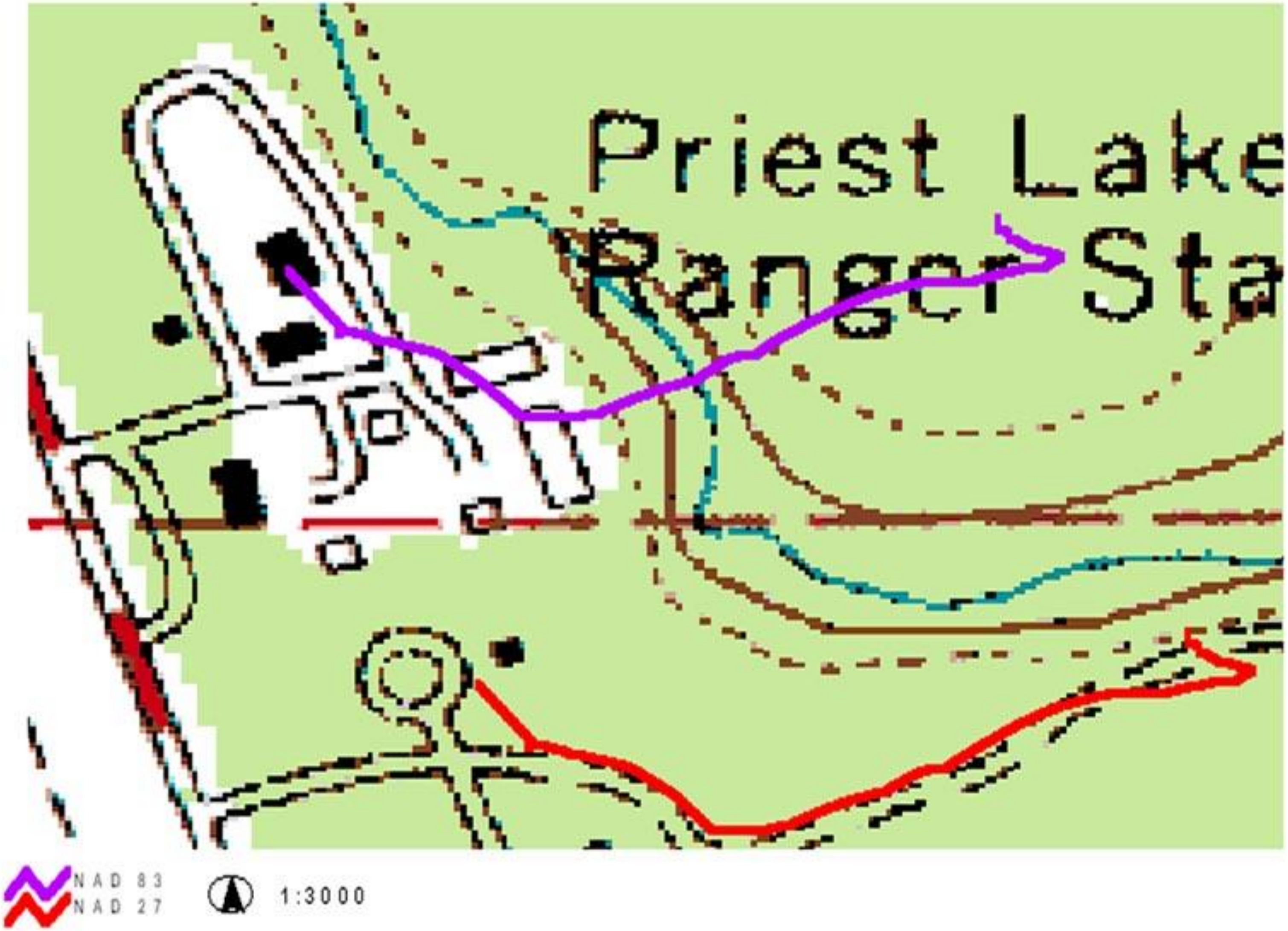
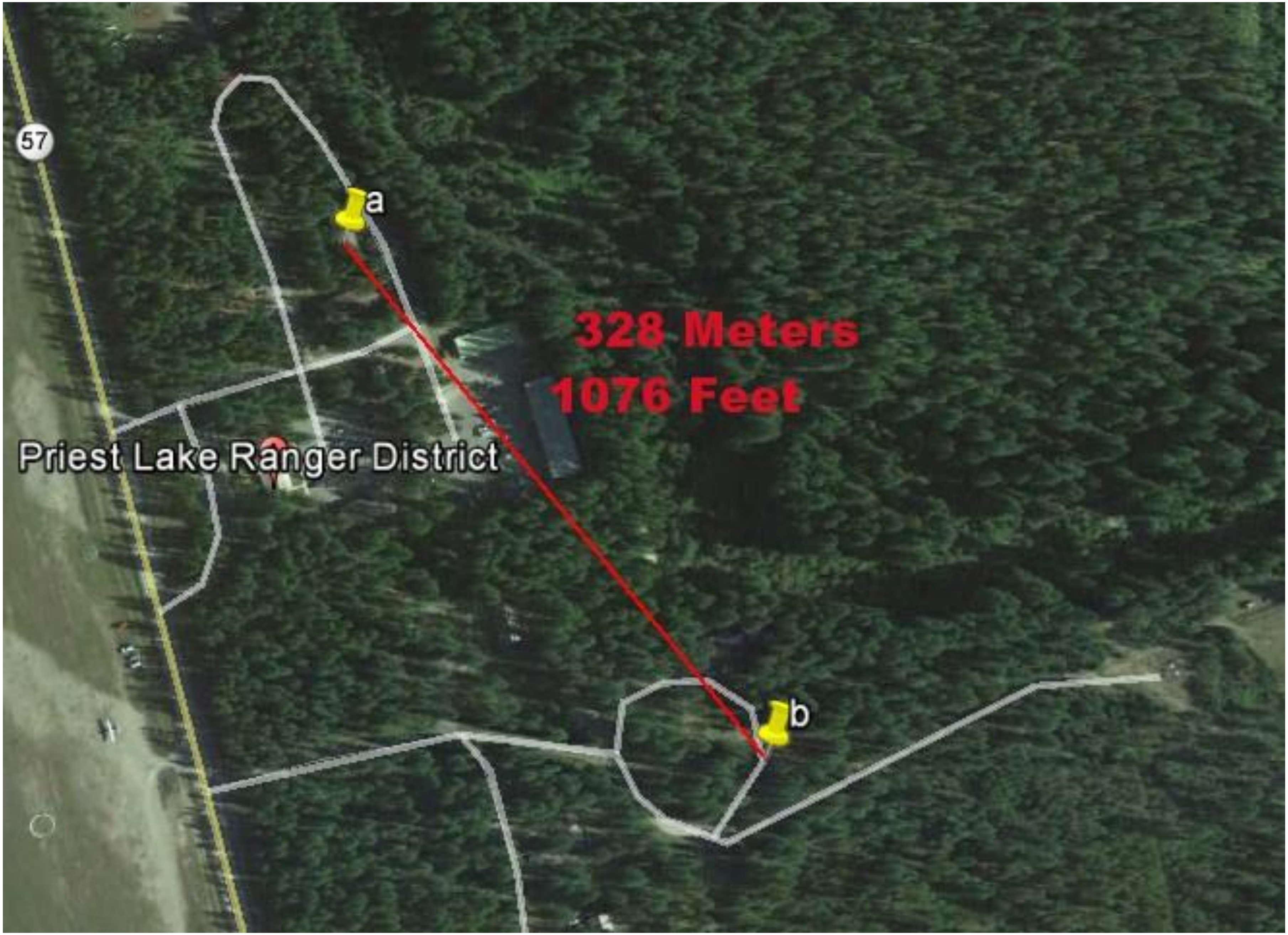
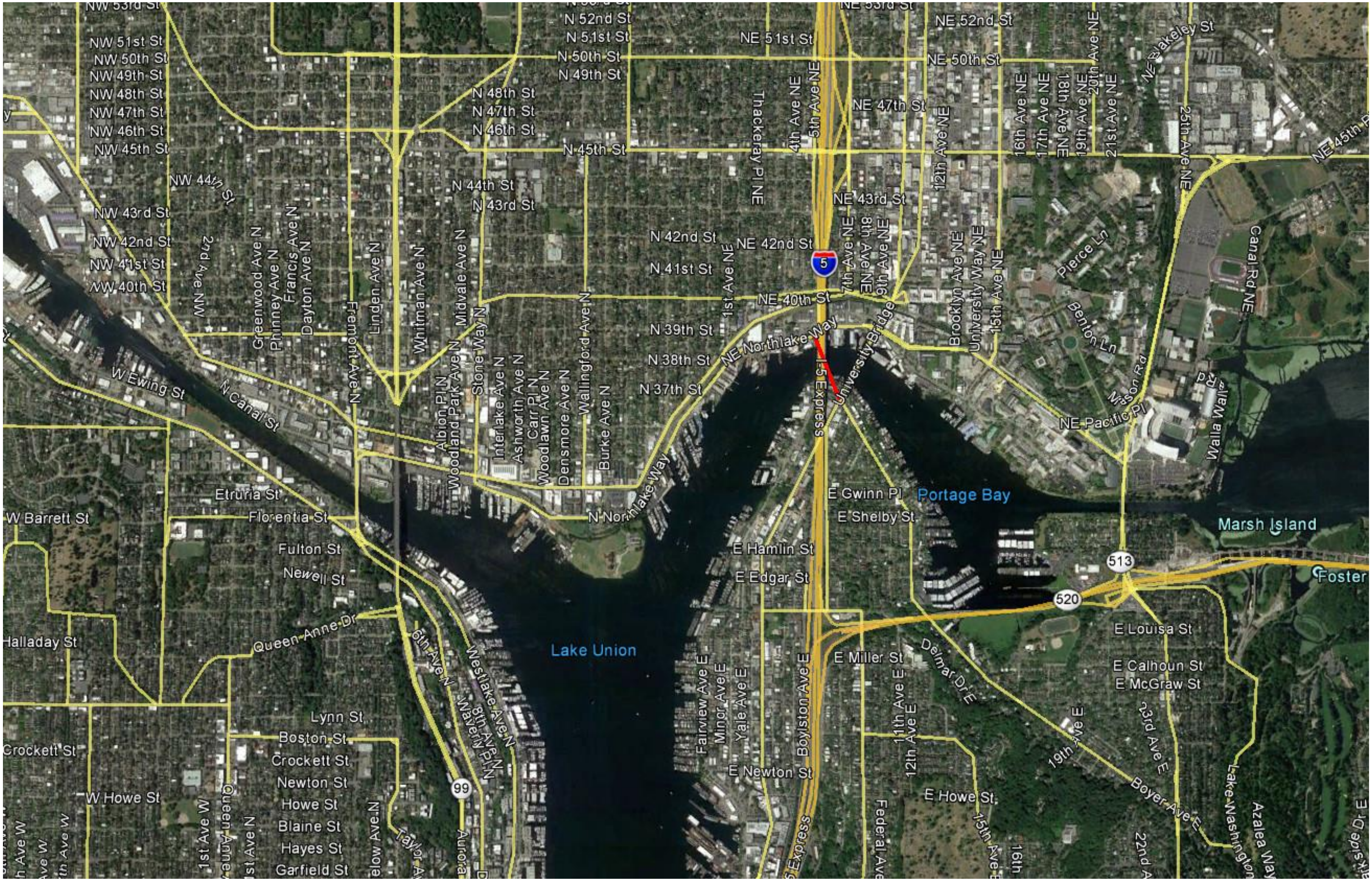
# What happens when datum is not set correctly!

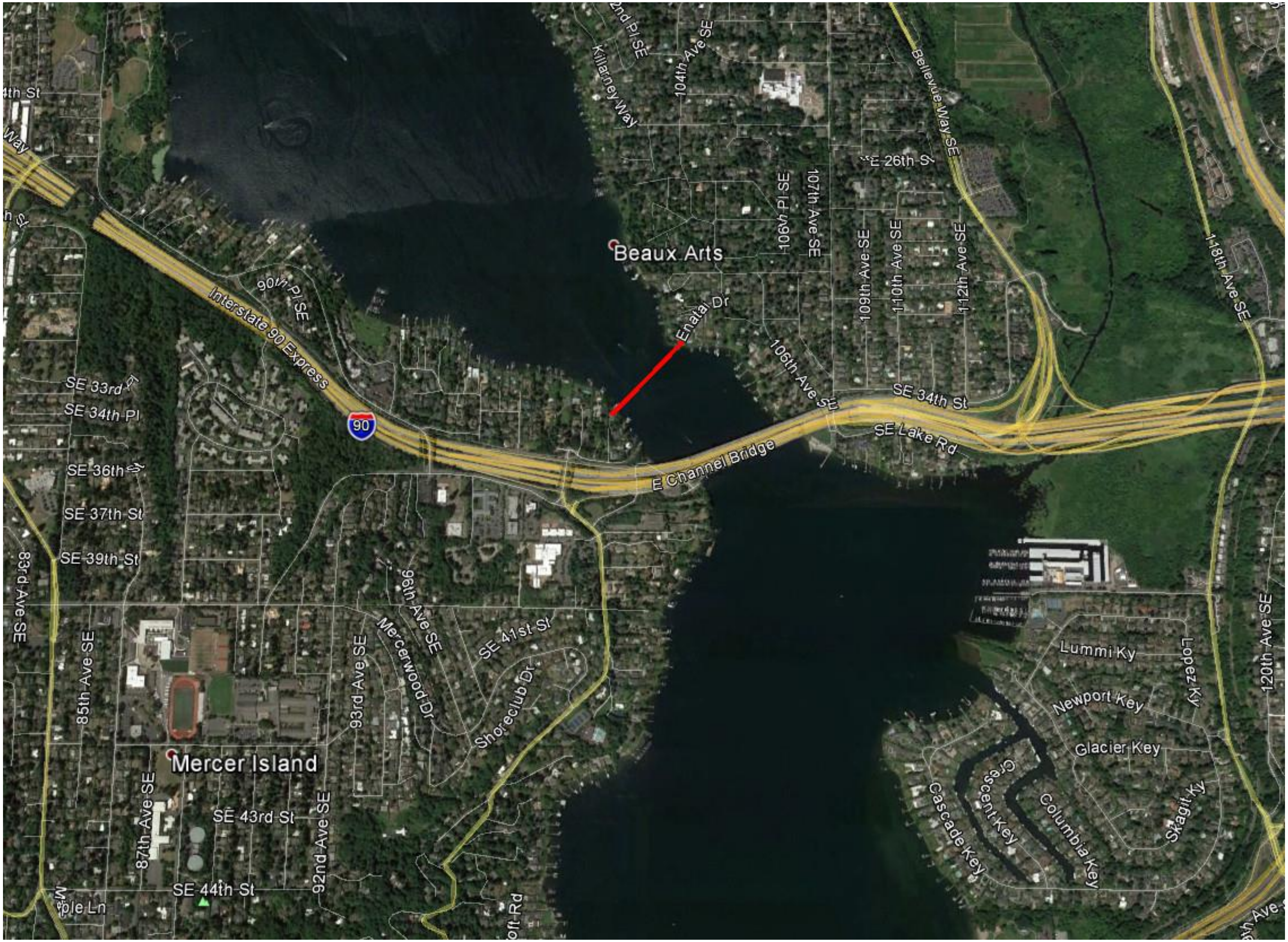



57
a
328 Meters
1076 Feet
Priest Lake Ranger District
b

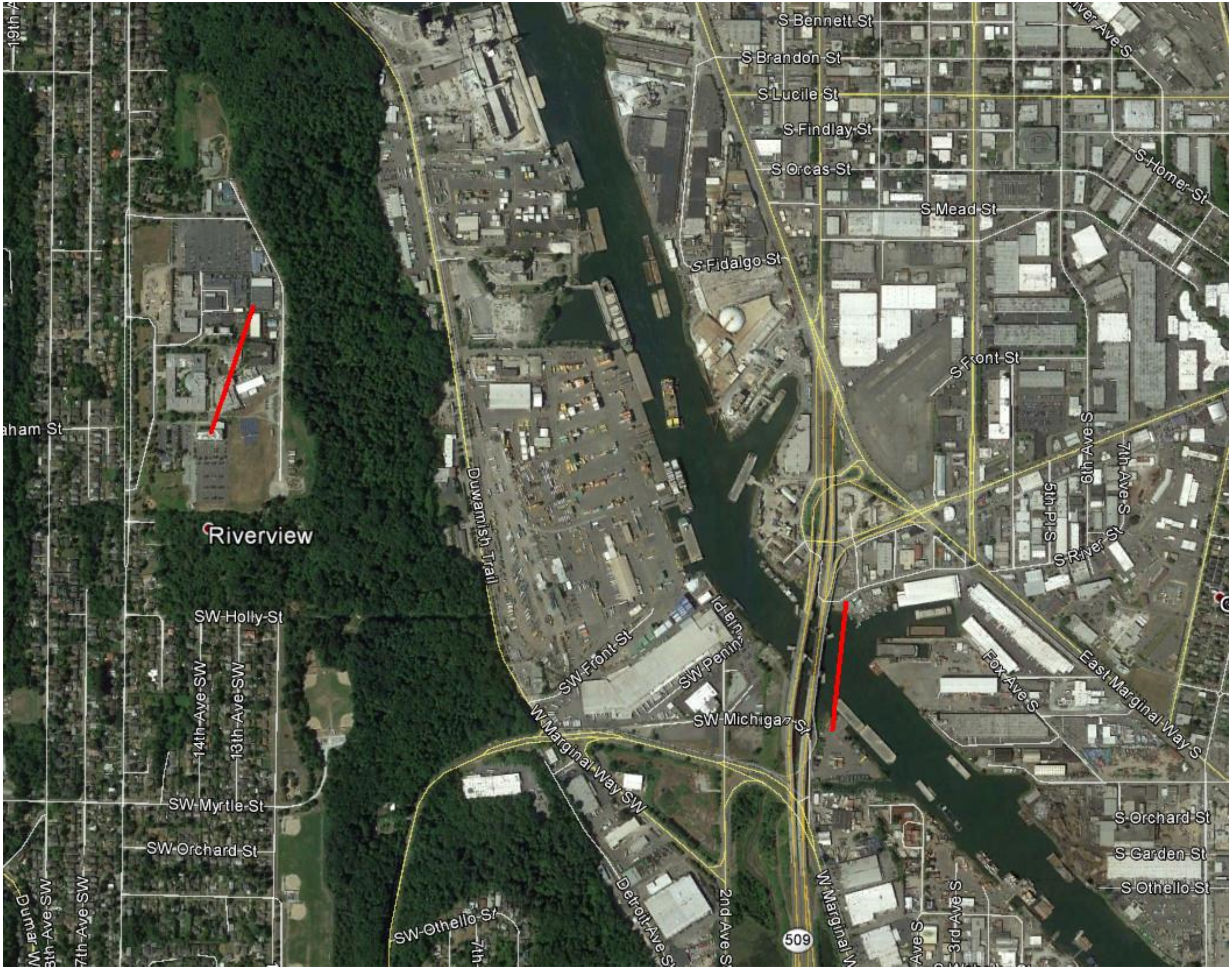
# Many parts of Ship Canal are less than 1000 feet wide.



# Bellevue versus Mercer Island



Wrong side of river. Six building away on this campus.



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